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May 1981 75p

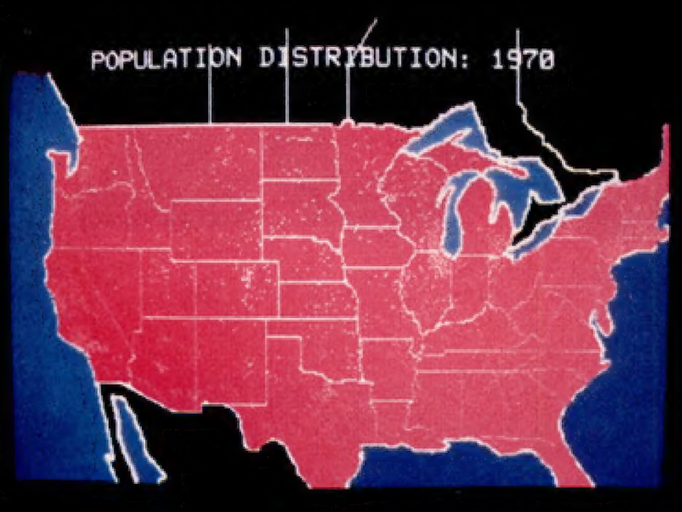
EUROPE'S LEADING MICRO MAGAZINE

PICKING A PROGRAMMER

Sort out the clowns from the competent

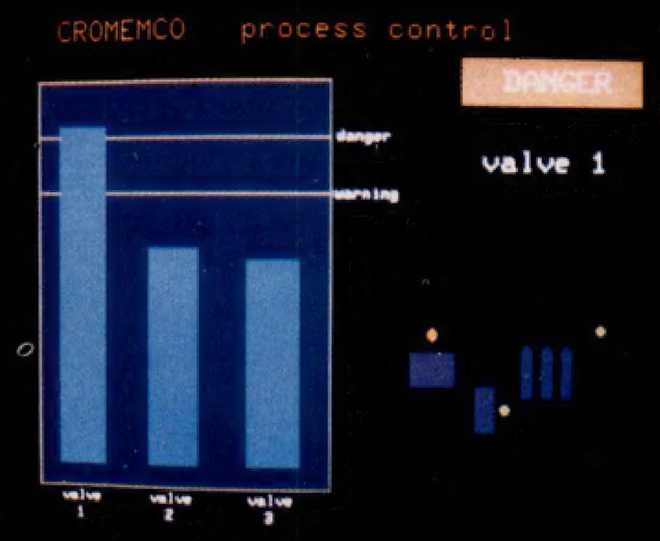
MicroCentre introduce . . . . . .

High Resolution Graphics

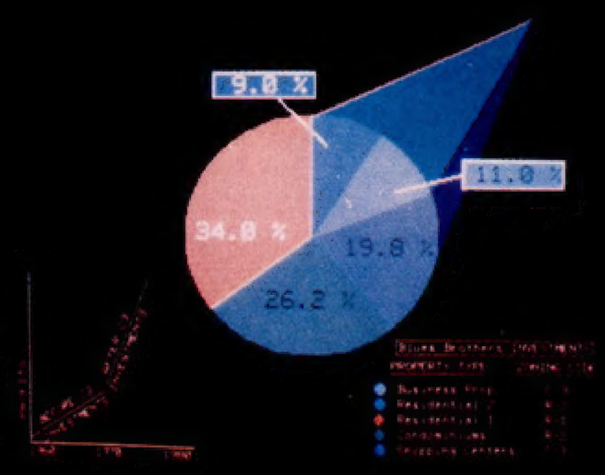


Demographic Display

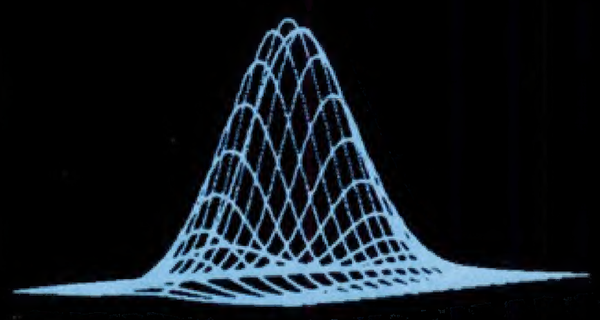
Management information



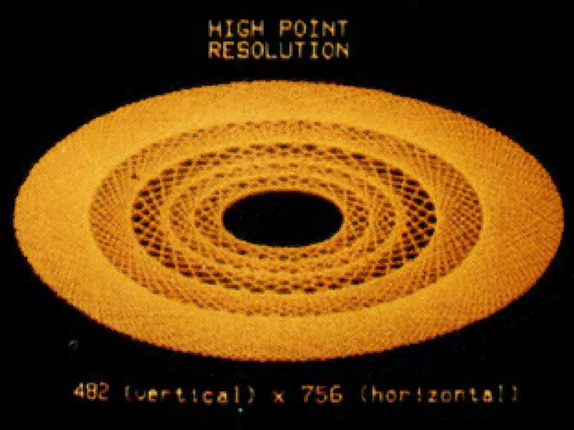
Control system display



3-D display with angled labels



3-D plots



High-resolution display with alphanumerics

Up to 16 colours can be displayed simultaneously, from a choice of 4069. Areas can be filled with colour, windows created, graphs plotted, etc—all under control of simple Basic, Fortran or Assembler functions.

At the heart of any Cromemco graphics system is Cromemco's "SDI" board, the most versatile video interface in the microcomputer industry today. The Cromemco SDI is designed to meet the challenge of professional and industrial environments where uncompromising performance, reliability, and continued compatibility are essential.
With its high point resolution, colour map selection, dual page windowing function, automatic fill mode, and NTSC or PAL broadcast compatibility, the most demanding requirements for a video interface can be met. The SDI provides a choice of 4096 individual colours and up to 754 by 482 point resolution. Its different modes of operation include bit or nybble mapped displays with varying levels of resolution, and window effects requiring as little as 12k data storage.

RGB-13 Colour Monitor

The Cromemco RGB-13 Colour Monitor has been specially designed for optimum colour graphics performance when used with Cromemco's SDI video interface. It includes a fine-pitch 13" CRT with a high-precision electron gun, internal magnetic shielding, and implosion protection band. The monitor combines alphanumeric character generation with colour graphics and high resolution, to give an overall performance vastly more superior than conventional colour TVs or CRT terminals.

Graphics Software

Cromemco's graphics software package provides an interface to Fortran IV, Ratfor, Macro Assembler, 16K Extended Basic and 32K Structured Basic. It is written for ease of use and takes full advantage of the RGB-13 monitor's special graphics facilities. Thus it is efficient, flexible and extremely fast. The package contains routines to change the colour map, scale the display area, draw dots, lines and circles, display text, and fill areas with colour. Screen addressing can be by absolute or relative co-ordinates.

Model Z2H/GS Graphics System

The Z2H/GS is a special configuration of the Z-2H Hard Disk computer which includes full graphics capability and software. Yet at under £8,000 it's a fraction of the cost of comparable systems. It is ideal for applications in medical imaging, computer-aided instruction, pattern recognition, and the television industry.

The Z2H/GS includes a Z-80A processor, 64k of RAM memory, integral 11 megabyte hard disk, RGB-13 colour monitor, 2 floppy disks, printer interface, RS-232 serial interface, and graphics software package.

The high-performance Z2H/GS colour graphics system includes a Z-2H hard disk computer, RGB-13 colour monitor, and comprehensive graphics software package—all for under £8,000!

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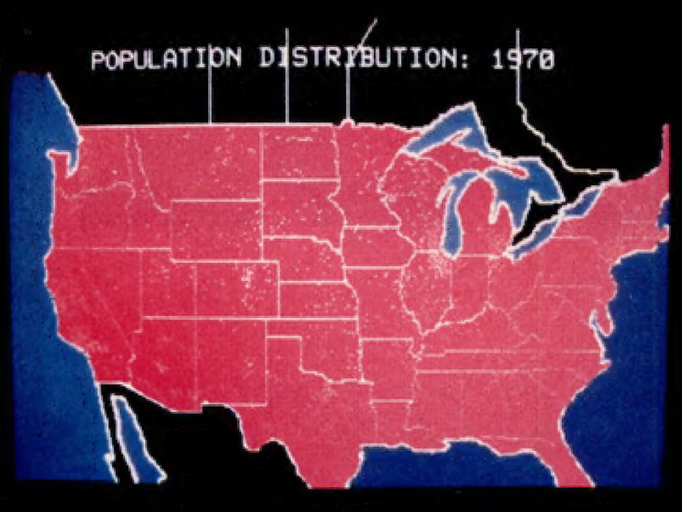

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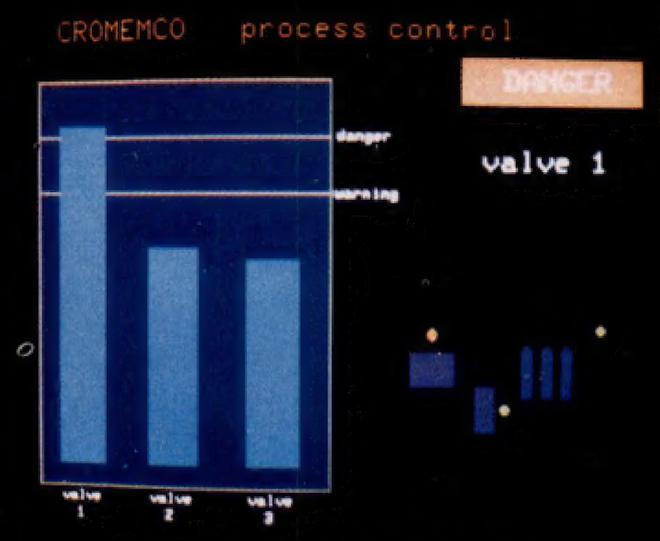

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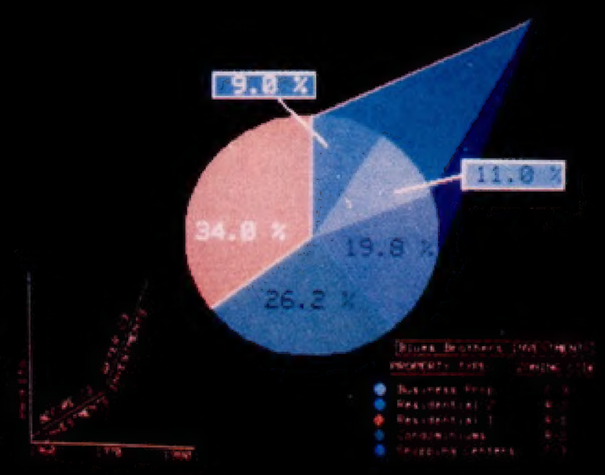

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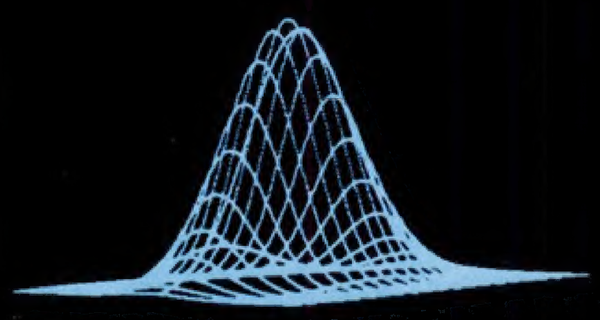

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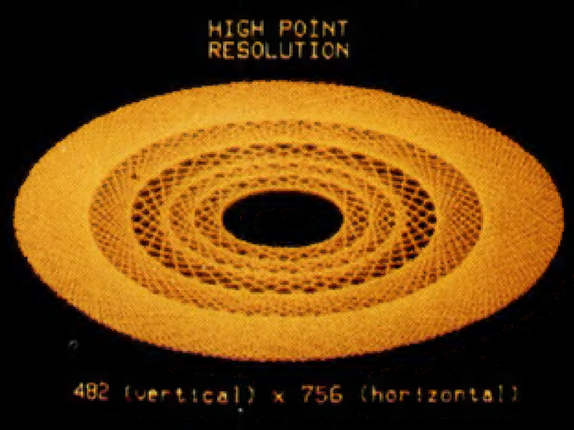

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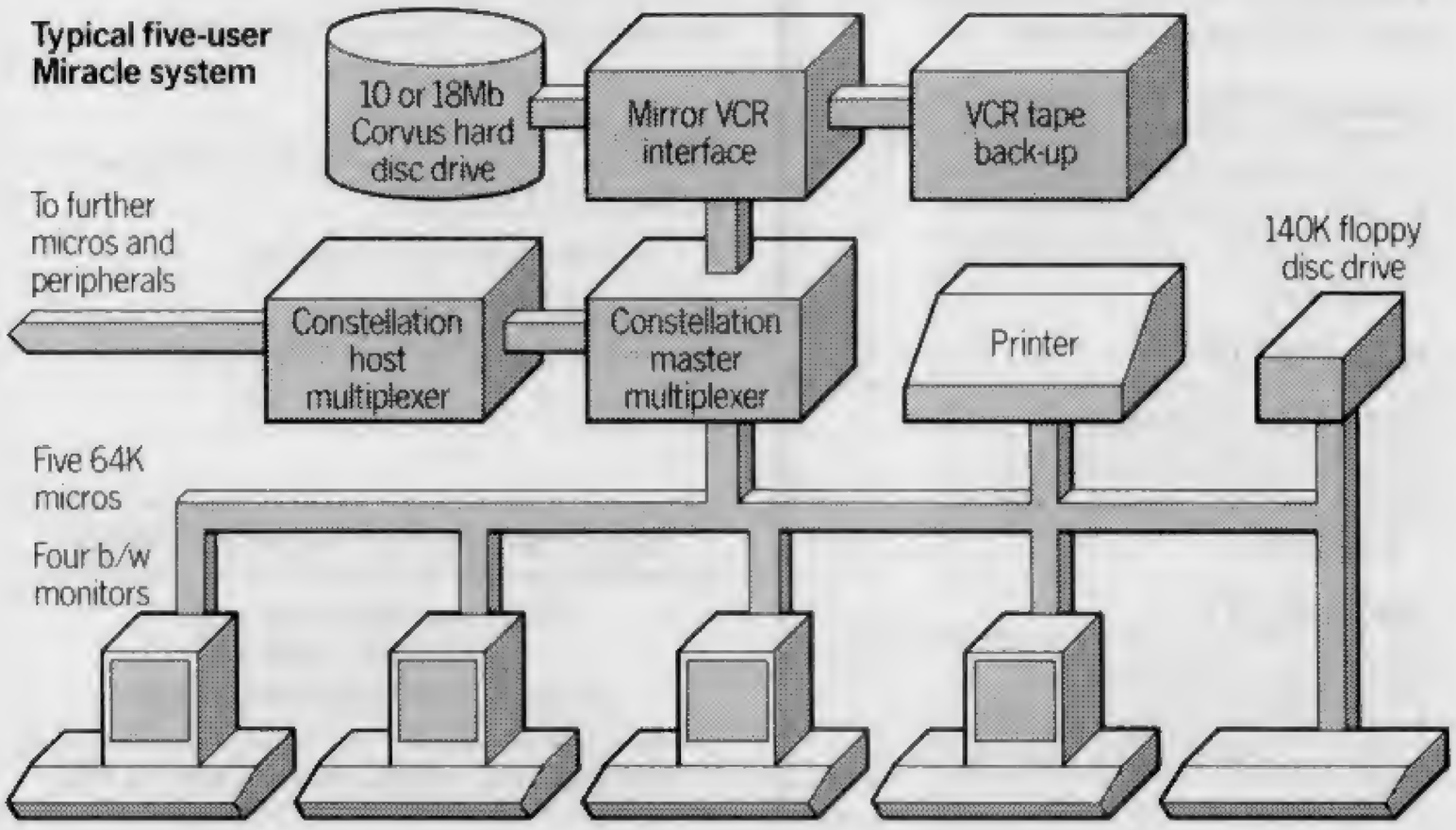

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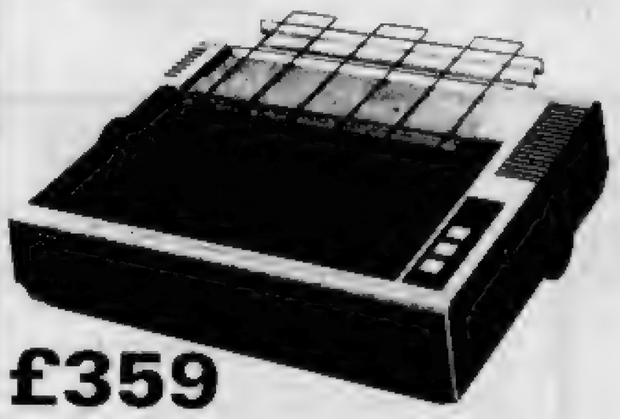

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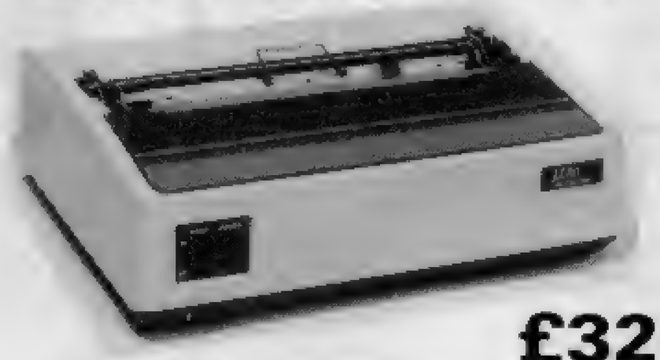

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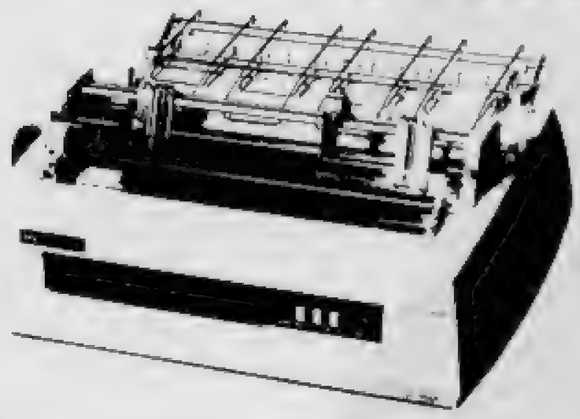

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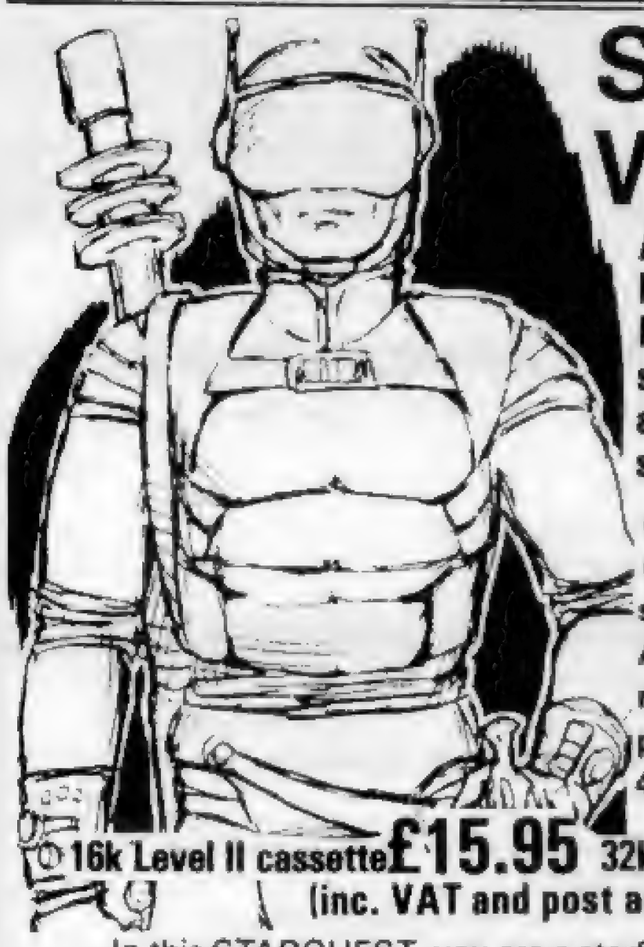

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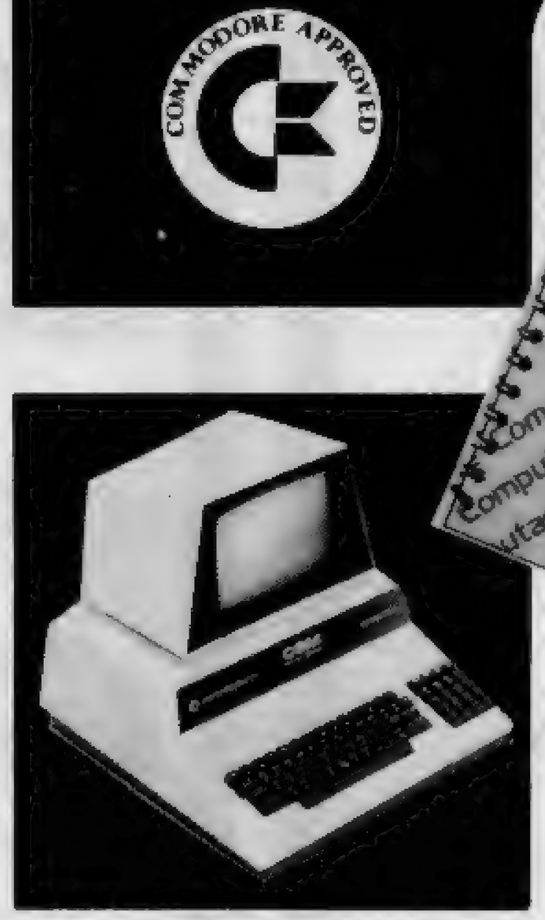

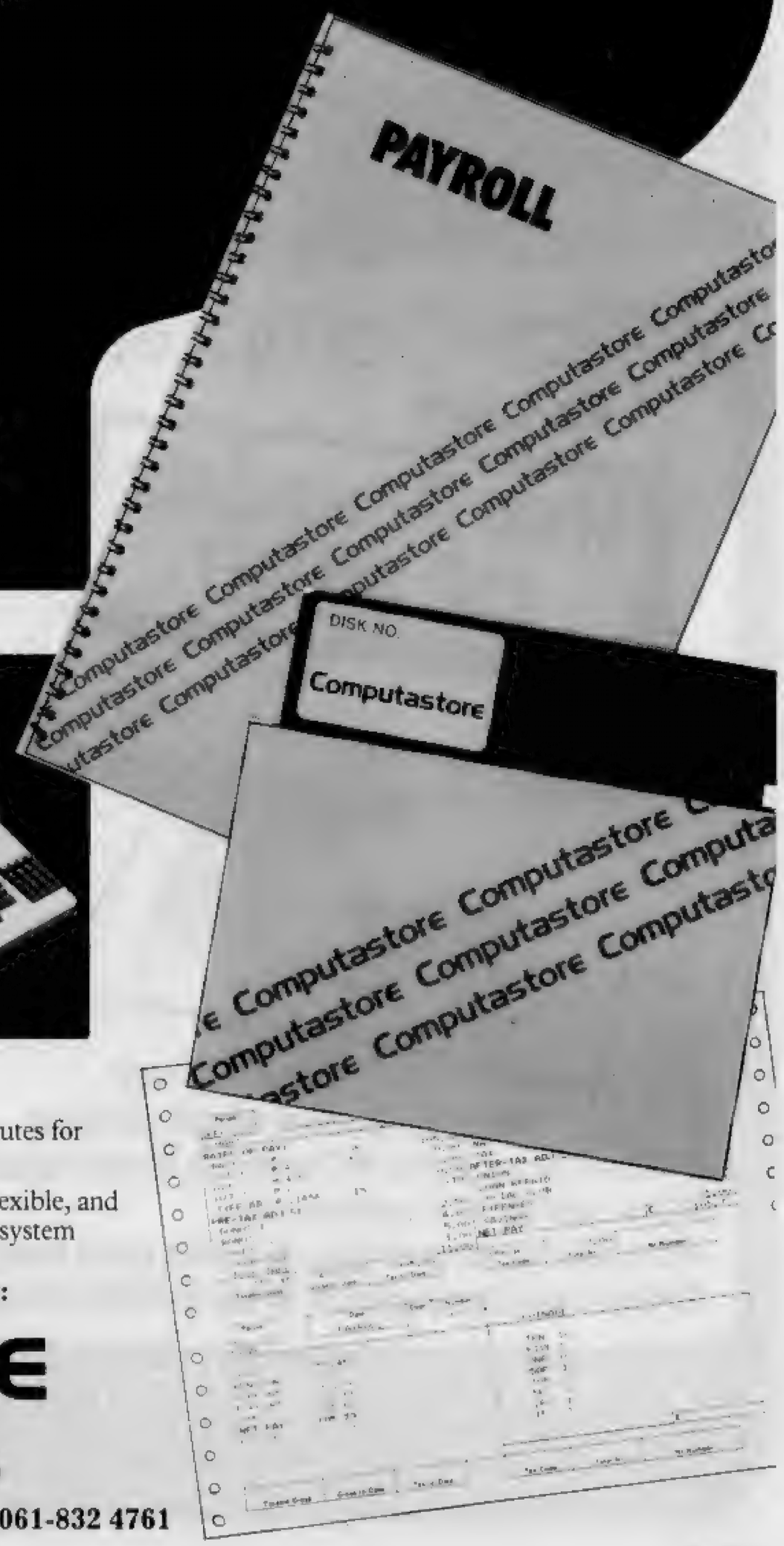

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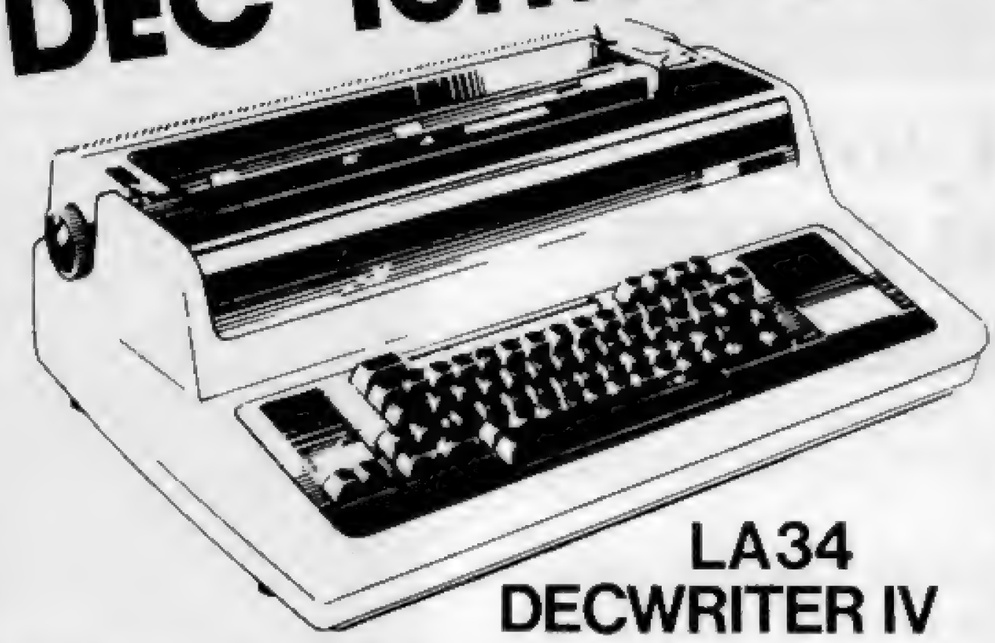

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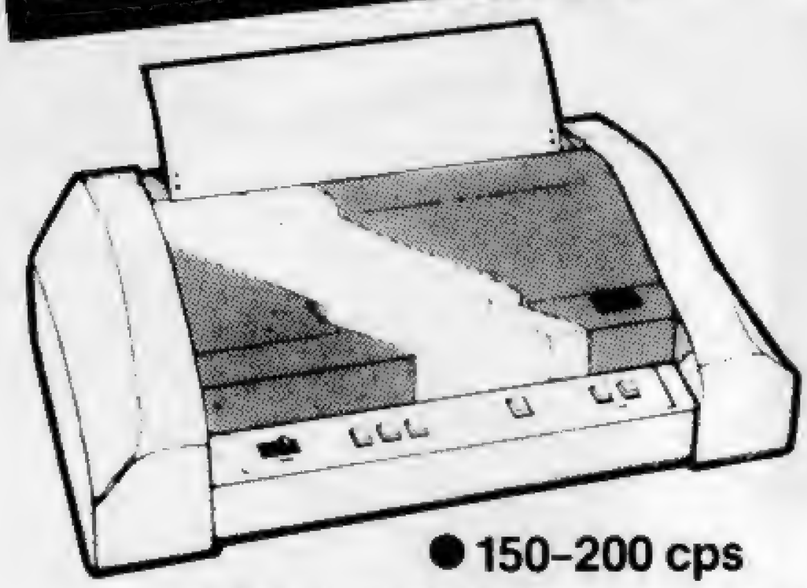

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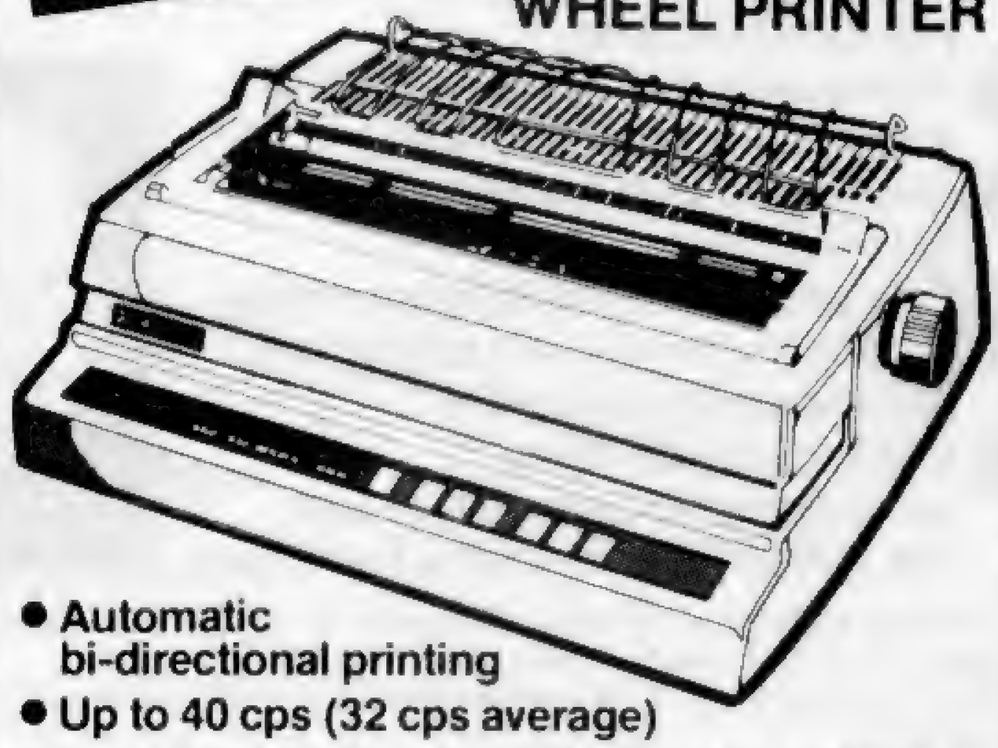

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- RS232-c or 20 mA interface
- Word processing options
- Optional tractors
- Optional cut sheet feeder

Wilkes Computing
Bush House, 72 Prince Street, Bristol BS1 4HU
Tel. (0272) 25921 Telex. 449205

The quality of the new SCRIPTA daisywheel printer is astonishingly good

-and so's the price from CPS

A lot is written about the quality of daisywheel printers, but how many people would be prepared to use one to make up an advertisement ? **This paragraph was actually printed on a SCRIPTA RO daisywheel printer for reproduction in this advertisement.

★★Will your printer pass the CPS underline test?

Manufactured in West Germany by world renowned Olympia International.

The SCRIPTA RO (receive only) model and the SCRIPTA KSR model which incorporates a full electronic typewriter keyboard, including auto corrector facility.

Both models are available with IEEE, RS232 Serial and Parallel Interfaces. So if you have a COMMODORE, APPLE, TANDY, SUPERBRAIN, NORTHSTAR HORIZON, CROMENCO, SORCERER, SHARP, 380Z etc. etc. CPS have a SCRIPTA printer for you.

There is a choice of several different daisywheel type styles and both printers use low cost carbon ribbon cassettes.

The equipment comes with a 90 day warranty.

CPS offer a full on-site maintenance contract.

You can buy, lease or hire your SCRIPTA from CPS.

Accessories available:

Rutishauser Tractor Feed **£175** +VAT

Rutishauser Cut Sheet Feed **£395** +VAT

Contact Nick Ashburner today at:-

CPS (DATA SYSTEMS) **LTD**

Third Floor, Arden House, 1102 Warwick Road, Acocks Green, Birmingham B27 6BH. Tel: 021-707 3866

A member of the CPS Group.

A quality wordprocessor from CPS is now only *£2,785 +VAT (CBM 8032, 4040, SCRIPTA RO and WordPro 4) *including FREE Data Desk

GW Computers Ltd

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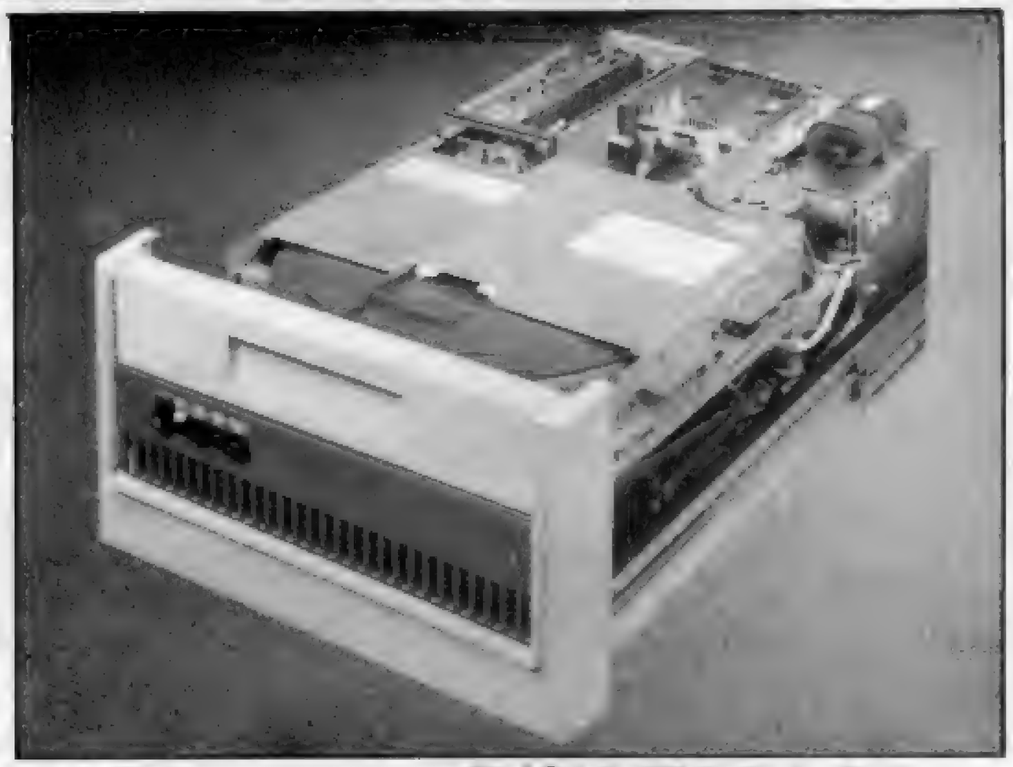

SUPERBRAIN™

Intelligent Video Terminal Systems

350K or 700K of Disk Storage

SuperBrain's CP/M operating system boasts an overwhelming amount of available software in BASIC, FORTRAN, COBOL, and APL. Whatever your application . . . General Ledger, Accounts Receivable, Payroll, Inventory or Word Processing, SuperBrain is tops in its class. And the SuperBrain QD boasts the same powerful performance but also features a double-sided drive system to render more than 700K bytes of disk storage and a full 64K of RAM. All standard!

COMPUSTAR™

MULTI-USER TERMINAL SYSTEM

CompuStar user stations can be configured in a countless number of ways. A series of three intelligent-type terminals are offered. Each is a perfect cosmetic and electrical match to the system. The CompuStar 10-a 32K programmable RAM-based terminal (expandable to 64K) is just right if your requirement is a data entry or inquiry/response application. And, if your terminal heads are more sophisticated, select either our CompuStar 20 or CompuStar 40 as user stations. Both units offer dual disk storage in addition to the disk system in the CompuStar. The Model 20 features 32K of RAM (expandable to 64K) and 350K of disk storage. The Model 40 comes equipped with 64K of RAM and over 700K of disk storage. But, most importantly, no matter what your investment in hardware, the possibility of obsolence or incompatibility is completely eliminated since user stations can be configured in any fashion you like — whenever you want — at amazingly low cost!

DISK STORAGE

Options for the Superbrain and Compustar Video Terminal

"Backup" for the 20 megabyte Century Data drive is provided via the dual disk system housed in the CompuStar or the SuperBrain. The Control Data CMD Drive features a removable, front-in-sertable top loading cartridge of 16 megabyte capacity plus a fixed disk capacity of either 16 or 80 megabytes.

Each drive is shipped equipped with an EIA standard 19" rack mounting system and heavy duty chassis slide mechanisms to permit easy accessability for fast and efficient servicing.

**** WIDELY USED IN UK AND USA ****
**** TESTED AND PROVEN ****
**** POWER AT YOUR FINGERTIPS ****
**** JUST COMPARE THIS LIST ****

No other program in the world combines these features in one. Many other programs, less integrated, do not provide even some of those features to be found on our 'bus'.

1 = Total integration of sales·'purchase 'nominal 'stock 'addresses etc
2 = Full random access enables retrieval of any record in a second
3 = Flexibles prompts enables word change even to foreign language.
4 = Files may be named and set to drive default, maximising storage.
5 = Easy to use, menu driven, no serious need of manual.
6 = Tested and debugged in many installations world wide.
7 = Priced less than the acquisition of a library of programs.
8 = The program is *** totally *** in core, maximising disk space.
9 = Core program means that disks may be interchanged during use.
10 = Core program means your main drive is *** free *** for data
11 = Numerous reports may be generated (eg: sale ledgers up to 30).
12 = Invoice produces immediate stock update + double journey entry.
13 = Reference on invoices enable cost centre build-up on ledgers.
14 = Stock valuations and re-order reports easily generated.
15 = Bank balance and reports plus standard mailing facilities.
16 = Customer statements and invoices printed on plain paper.

*** SALES COMMENT ***

As prices vary from dealer to dealer we append for your guidance, some details of the justification in our prices being higher than the cash/carry concept of trade.

A standard Superbrain 64K ★320K Disk at 1795.00 includes the following values not normally expected at the lower price.

1) Equipment is burned and tested for a minimum 48 hours
2) Delivery in U.K. is free of charge
3) All goods & software are stocked on immediate delivery
4) 6 month main unit, 12 month memory guarantee
5) 24/48 hour mailing of any spare module free within warranty
6) Same service as 5) outside warranty for ad hoc charge
7) 10 free Diskettes (28.50)
8) 10% of hardware value in free software (1795.00)
9) Positive before ** and ** after sales service

If the transaction includes a printer and the business programs then the following are also added:

10) All cabling between printer and Superbrain free (25.00)
11) Ribbon and thimble free (eg: Spinwriter 4.75 + 9.75)
12) Extra 10 Diskettes free (28.50)
13) Additional free software based on 10% of printer value
14) Free training session plus all necessary follow up
15) Box printer paper (28.50)

A typical deal could look like this:

Superbrain	1795.00
NEC Spinwriter	1695.00
	3490.00

BUS Program 775.00 plus Basic 150.00 (less 349.00) = 576.00
Total Purchase Price 4066 plus V.A.T.

The total value of free items on this deal was in excess or 500 pounds in virtue of incidental items as well as extended warranty and software.

Do consider your purchase on the basis of some of the things you may be likely to need after your equipment purchase, and may either fail to obtain because the dealer has no stock or has lost interest in you, or because you aimed at the short term gain in price and are then compelled to pay heavily for small needs afterwards.

GRAMA WINTER CALLERS BY APPOINTMENT ONLY
LONDON WC1. TEL NO. 636 8210/631 4818

*** MAIN MENU DISPLAY ***

New! Produced in U.K. and widely used in England and the U.S.A.
Complete Business Package

INCLUDES EVERYTHING FROM INVENTORY TO SALES SUMMARY
PROMPTS USER AND VALIDATES ENTRIES. MENU DRIVEN

PET AND CP/M SUPERBRAIN, TRS80 ii, N'STAR, IMS5000.
APPROXIMATELY 60–100 ENTRIES/INPUTS REQUIRE 2–4 HOURS WEEKLY
AND ENTIRE BUSINESS IS UNDER CONTROL

* PROGRAMS ARE INTEGRATED .. SELECT FUNCTION BY NUMBER ....

01=*ENTER NAMES AND ADDRESSES
02=*ENTER/PRINT INVOICES
03=*ENTER A'C RECEIVABLES
04=* ENTER PURCHASES
05=*ENTER A'C PAYABLES
06=*ENTER'UPDATE INVENTORY
07=*ENTER'UPDATE ORDERS
08=*ENTER'UPDATE BANKS
09=*REPORT SALES LEDGER
10=*REPORT PURCHASE LEDGER
11=*INCOMPLETE RECORDS
12=*USER DBMS AREA
13=*PRINT CUSTOMERS STATEMENTS
14=*PRINT SUPPLIER STATEMENTS
15=*PRINT AGENT STATEMENTS
16=*PRINT TAX STATEMENTS
17=LETTER TEXT AREA
18=ALTER VOCABULARIES
19=PRINT YEAR AUDIT
20=PRINT PROFIT'LOSS A'C
21=OPEN AREA
22=PRINT CASHFLOW FORECAST
23=ENTER PAYROLL (NO RELEASE)
24=DISK SWAP'EXIT

DATABASE MANAGEMENT INCLUDES

*** FILE OR RECORD CREATE'DELETE'AMEND'SEARCH'PRINT 4 WAYS *** INFORMATION RETRIEVAL ON ANY KEY RECORD OR PART THEREOF *** AUTOMATIC CHECK TO PREVENT DOUBLE ENTRY TO FILE SYSTEM *** DYNAMIC ALLOCATION OF INFORMATION CONSERVING DISK SPACE.

VERY FLEXIBLE. EASY TO USE.
G.W. COMPUTERS LTD. UK ARE THE PRODUCERS OF THIS BEAUTIFUL PACKAGE. *AUTHOR* TONY WINTER (B.A.LIT; B.A.HON.PHIL).
PET VER 3.00 LOW LEVEL INTEGRATION = 475.00. PET VER 4.00 INCLUDES AUTO STOCK-UPDATE = 575.00. PET VER 5.00 INCLUDES AUTO BANK UPDATE = £675.00. CPM VER 6.00 IN CORE, TRANSLATABLE PLUS DBMS = 775.00. CPM VER 7.00 AUTO STOCK-UPDATE = 875.00. CPM VER 8.00 AUTO BANK UPDATE = 975.00. CPM VER 9.00 INCLUDES OPTIONS 19, 20, 22, 23 (LATER RELEASE). +++ EACH LEVEL AUGMENTS LOWER ONE.

WE EXPORT TO ALL COUNTRIES CALLERS ONLY BY APPOINTMENT
CONTACT TONY WINTER ON 01-636 8210 01-631 4818
CALLERS BY APPOINTMENT ONLY

NOTE!!! LEVEL 9.00 TOTALLY IN CORE PROGRAM LEAVES MASTER DRIVE FREE (SAVING OF 200 POUNDS HARDWARE).

IMPORTANT!!! No computer hardware is ever of value without software, so we provide you with a starting set of programs **** free **** at 10% of hardware purchased.
A Superbrain and NEC Spinwriter could give you up to 400 pounds of programs. See [ ].

PET + PET + PET + PET + SOFTWARE + SOFTWARE + SUPERBRAIN + SUPERBRAIN

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CBM 3040 DISKS	595.00
CBM 3022 PRINTER	425.00
CBM 8032 32K	875.00
CBM 8050 1MEG DISKS	875.00
CBM EPSON PRINTER	395.00
CBM MULTI USER	850.00
CBM 3032 + EPSON + ...	
CBM 3040 + BUS V3	2215.00

PRINTERS + PRINTERS +

DIABLO 630 40CPS	1595.00
DOLPHIN BD80 125CPS	495.00
NEC 5510 PRINTER	1695.00
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DEC-LA34 TRACT 30CP	875.00
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SPECIALS + SPECIALS +

N'STAR QUAD .7 MEG	1500.00
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COMPUTHINK * 800K *	795.00
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BUS VER	6.00	CP'M	775.00
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CPM* COBOL 80			320.00
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TWIN Z80 32K+CRT.			
+2 D'D–S'S DRIVE.			

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Products include:- Universal Interface Card, Machine Language and Z-80 Assembler packages, CP/M* plus a comprehensive range of software.

*Trade mark of Digital Research Ltd.

You'll find all the help and advice you need about the MZ-80K at your Specialist Sharp Dealer in the list below.

If there is no dealer in your area, or if you require any further information write to:-
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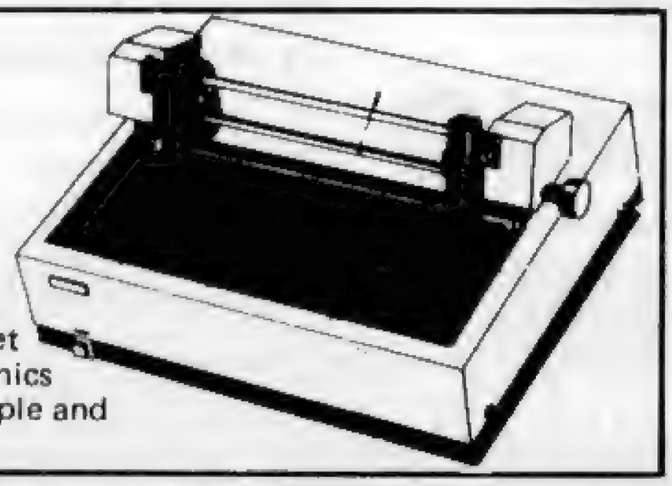

Dot-matrix printer with Pet graphics interface: Centronics parallel, options: PET, Apple and compatible

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6850	3.60
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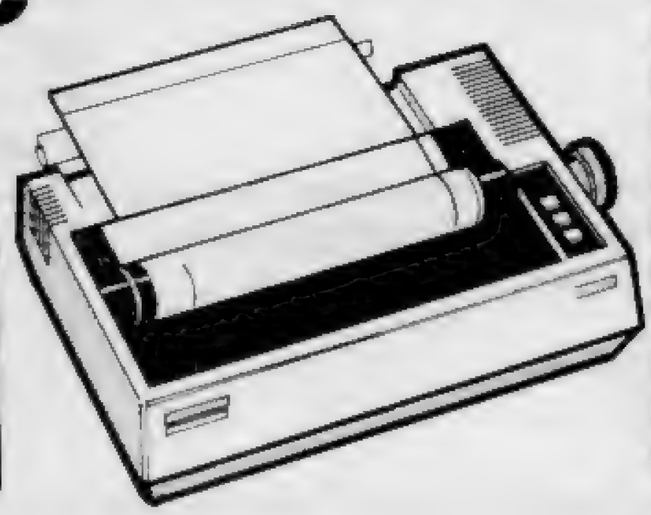

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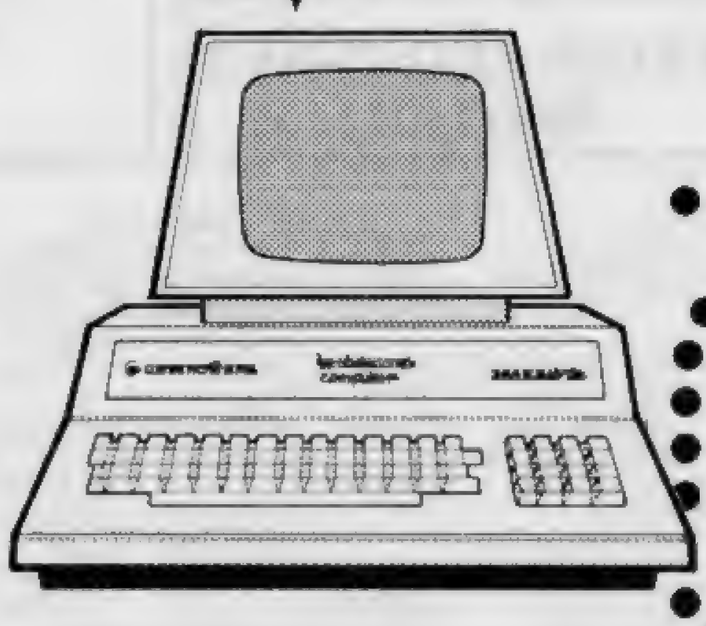

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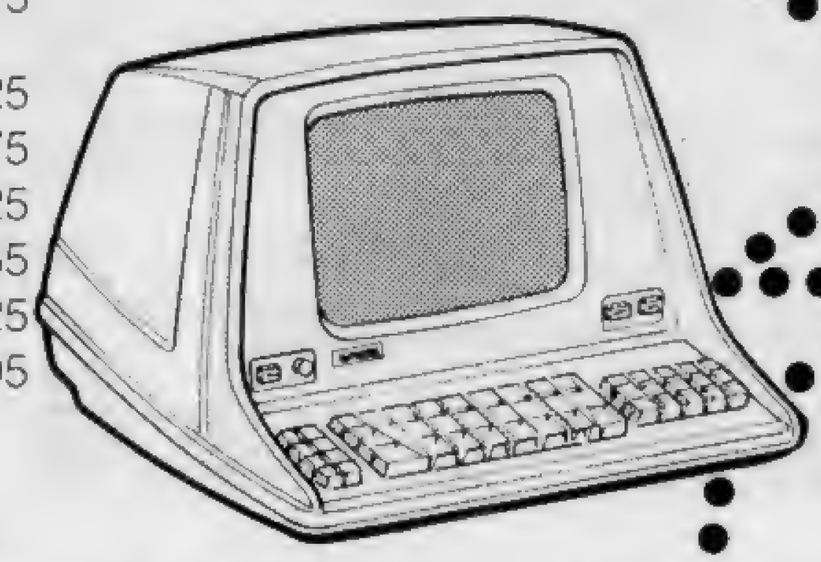

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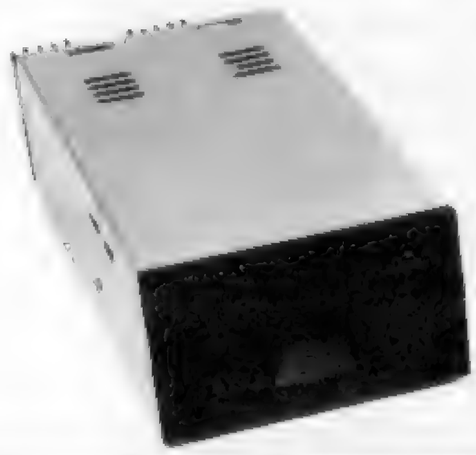

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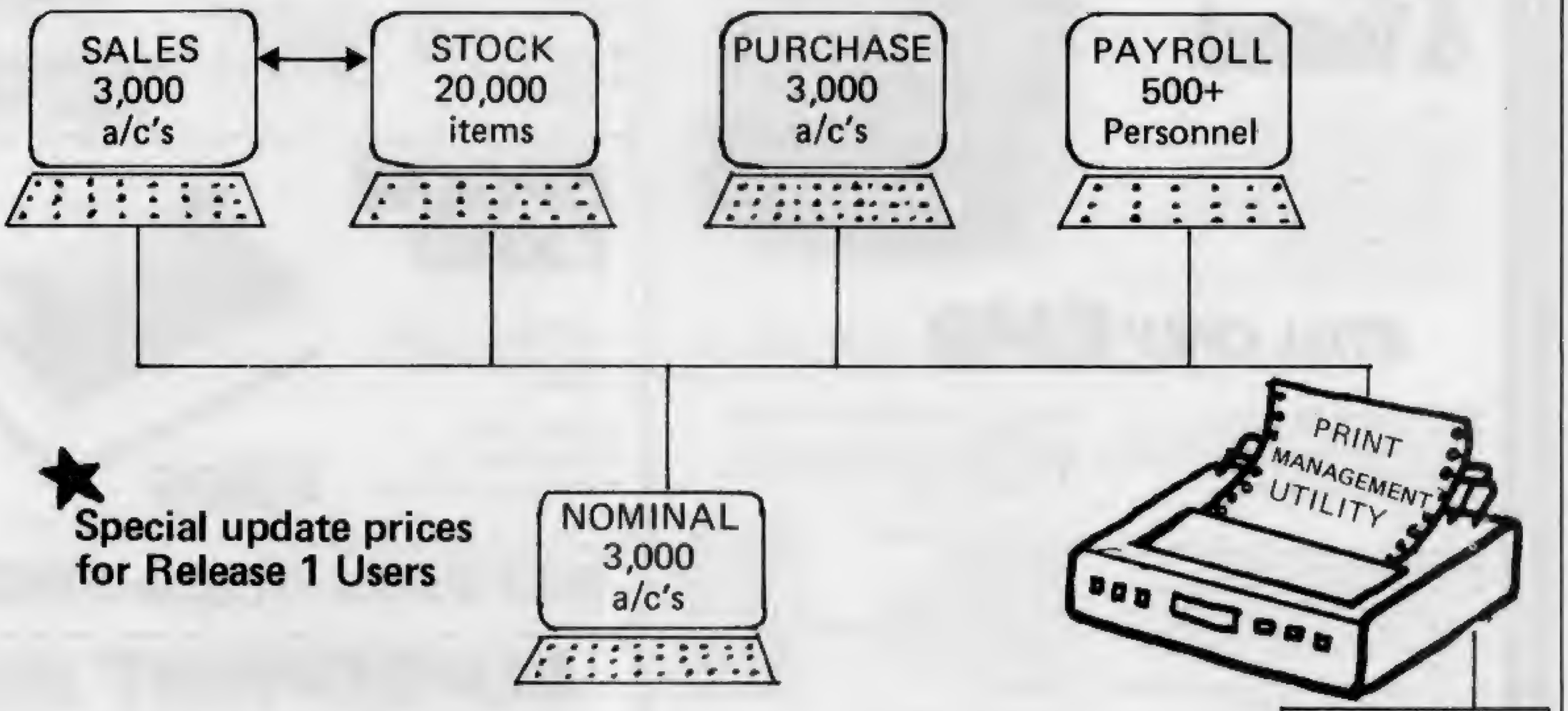

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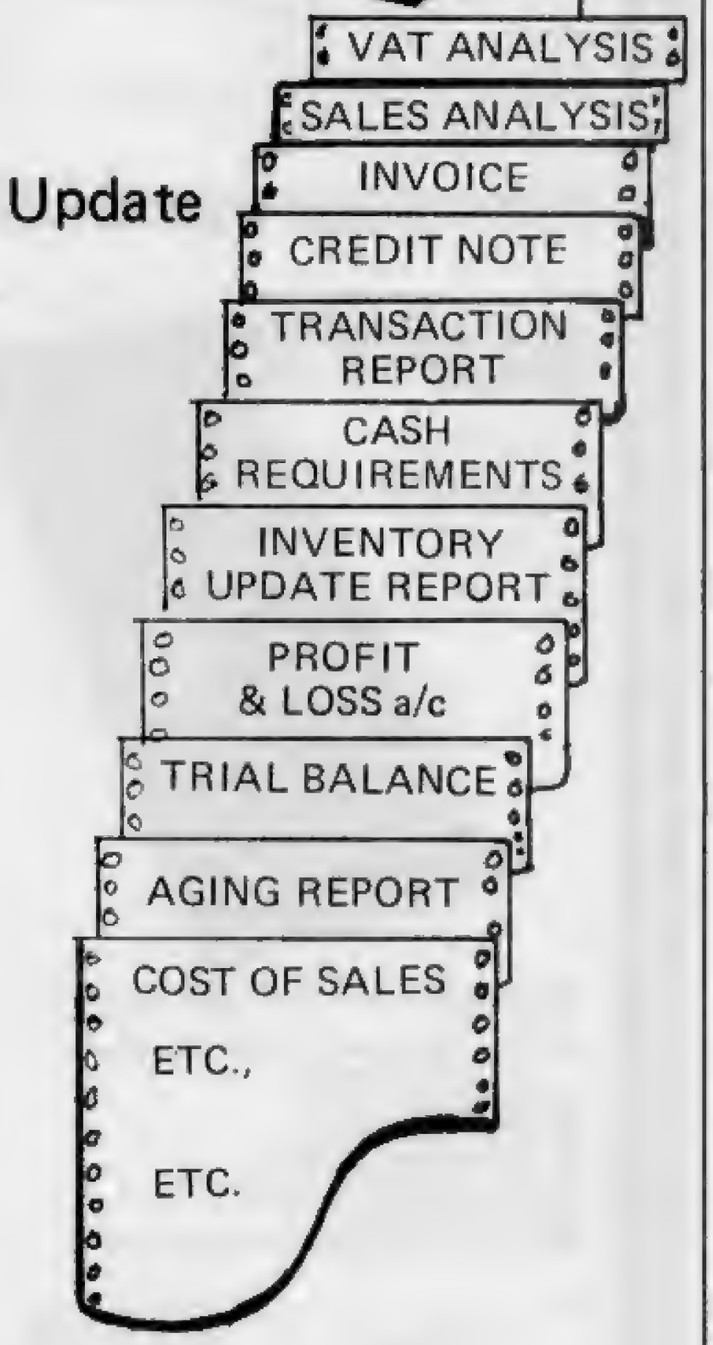

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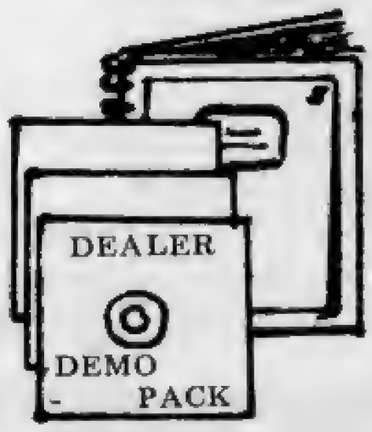

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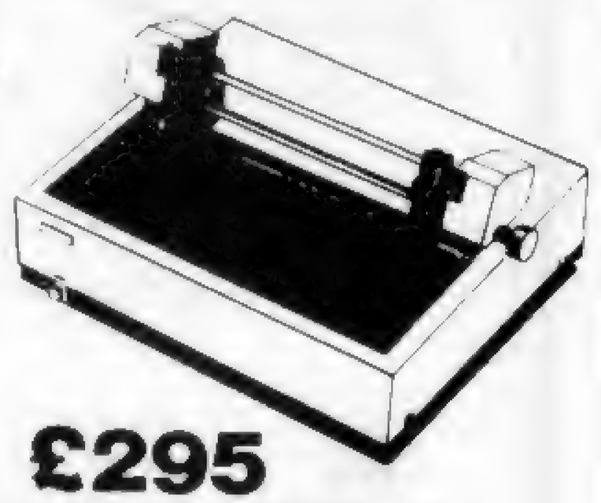

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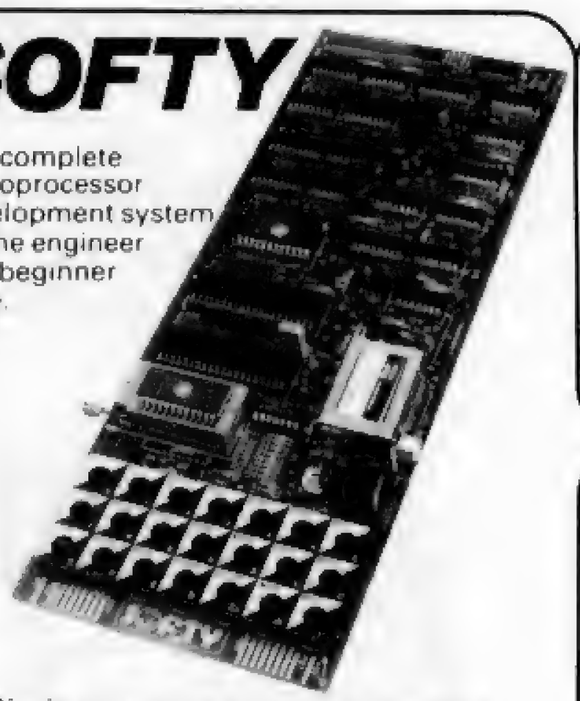

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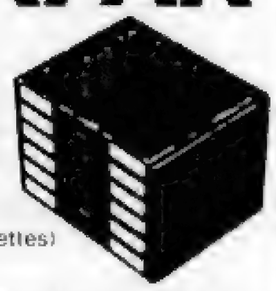

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7416	30
7417	30
7420	19
7421	38
7422	25
7423	28
7425	28
7426	43
7427	32
7428	35
7430	19
7432	27
7433	36
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7441	68
7442	58
7443	120
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7445	105
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7447	72
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7453	20
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7470	40
7472	30
7473	35
7474	34
7475	56
7476	40
7480	52
7481	120
7482	75
7483	90
7484	99
7485	105
7486	33
7489	205
7490	42
7491	84
7492	50
7493	57
7494	85
7495	70
7496	80
7497	176
74100	130
74104	62
74105	62
74107	34
74109	60
74110	54
74111	68
74112	170
74116	170
74118	85
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74120	75
74121	35
74122	50
74123	65
74125	50
74126	45
74128	45
74132	55
74136	55
74141	75
74142	185
74143	250
74144	250
74145	90
74147	150
74148	125
74150	130
74151	70
74153	70
74154	120
74155	75
74156	75
74157	70
74159	165
74160	99
74161	99
74162	99
74163	99
74164	120
74165	120
74166	130
74167	205
74170	205
74172	375
74173	110
74174	100
74175	82
74176	80
74177	85
74178	110
74179	150
74180	90
74181	280
74182	85
74184	130
74185	130
74188	310
74190	130
74191	120
74192	120
74193	120
74194	102
74195	75
74196	99
74197	88
74198	160
74199	160
74221	150
74246	150
74247	151
74248	189
74249	189
74251	110
74265	66
74273	267
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LS32	25
LS33	35
LS37	30
LS38	35
LS40	28
LS42	66
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LS51	25
LS54	30
LS55	30
LS63	150
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LS74	35
LS75	45
LS76	45
LS78	50
LS83	105
LS85	80
LS86	38
LS90	50
LS91	125
LS92	75
LS93	60
LS95	115
LS96	120
LS107	45
LS109	75
LS112	40
LS113	75
LS114	40
LS122	70
LS123	75
LS124	180
LS125	45
LS126	45
LS132	60
LS133	35
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LS138	70
LS139	70
LS145	120
LS147	210
LS148	170
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LS153	85
LS155	75
LS156	85
LS157	70
LS158	70
LS160	90
LS161	98
LS162	110
LS163	95
LS164	115
LS165	145
LS166	175
LS168	210
LS169	210
LS170	288
LS173	105
LS174	110
LS175	110
LS181	295
LS183	298
LS189	128
LS190	95
LS191	95
LS192	95
LS193	99
LS194	125
LS195	130
LS196	120
LS197	85
LS200	345
LS202	345
LS221	120
LS240	165
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LS273	180
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LS283	90
LS290	130
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LS299	420
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LS302	175
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LS324	200
LS325	320
LS326	330
LS327	315
LS346	185
LS347	150
LS348	190
LS352	185
LS353	185
LS365	65
LS366	65
LS367	65
LS368	90
LS373	150
LS374	150
LS375	150
LS377	199
LS378	140
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LS384	250
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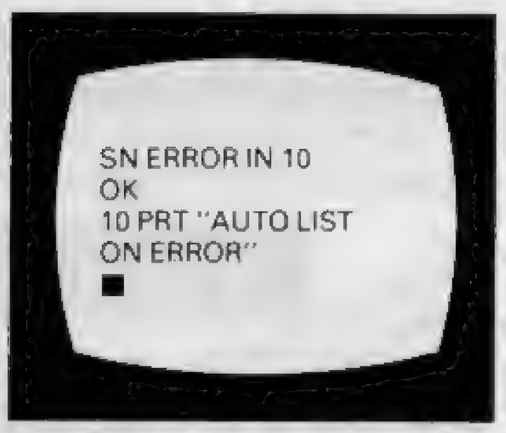

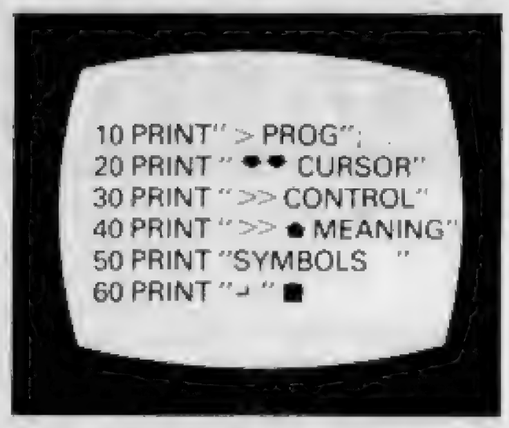

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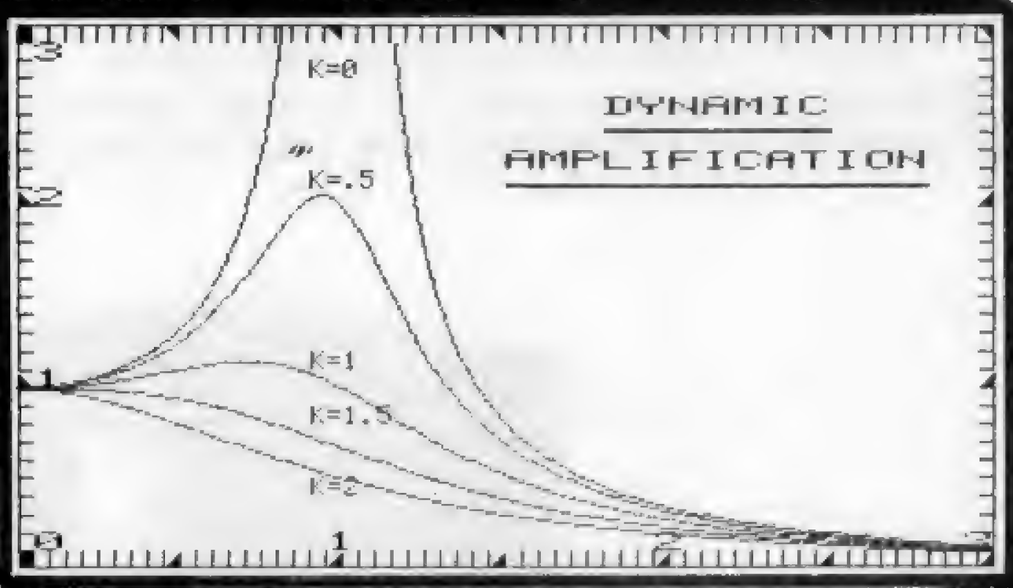

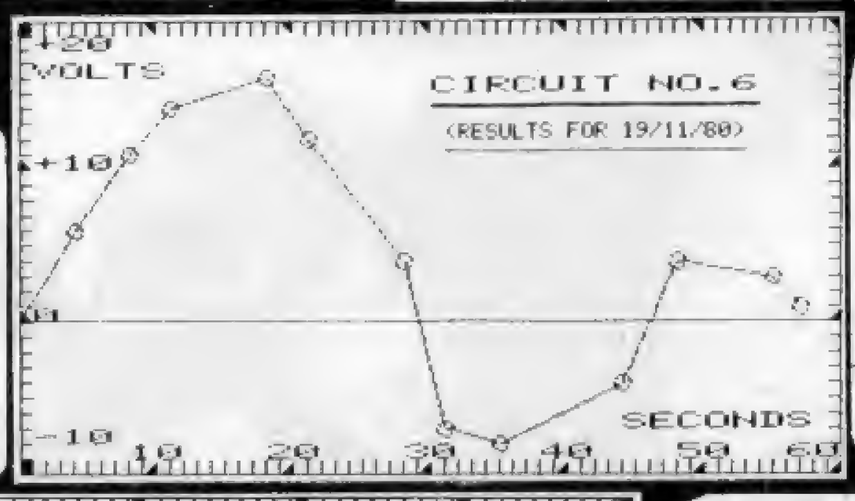

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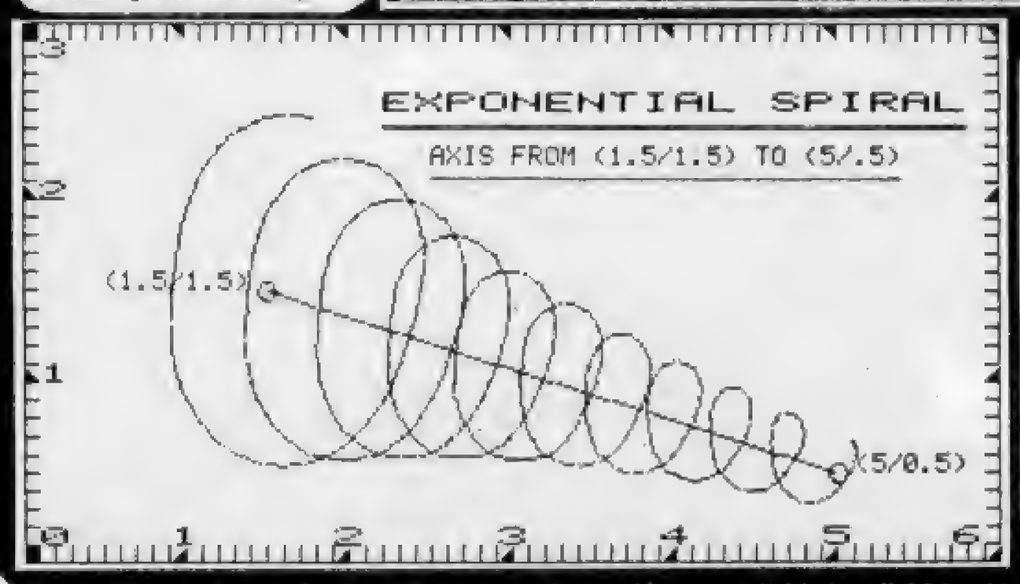

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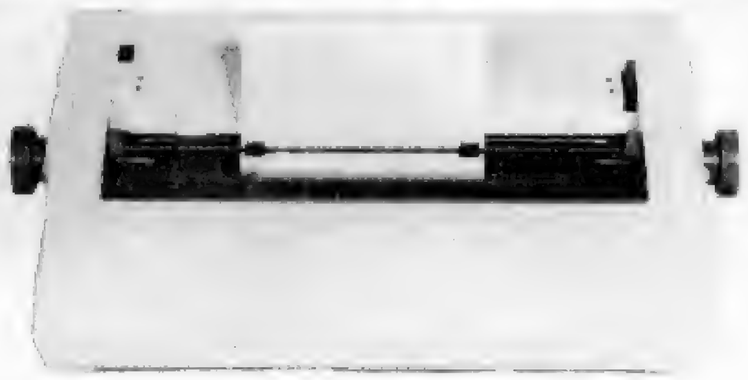

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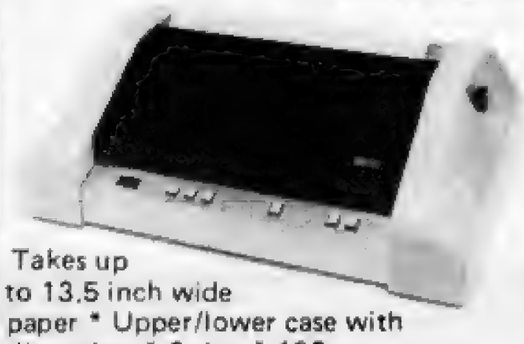

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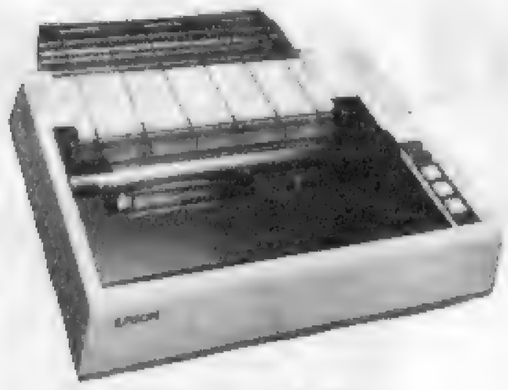

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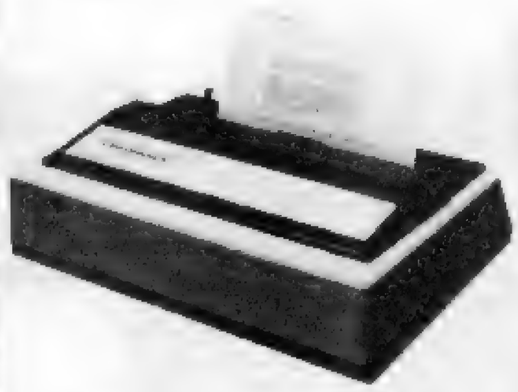

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NEWSPRINT

Guy Kewney, editor of Datalink, *presents the latest micro news.*

Licence law?

It is time somebody seriously started thinking about the idea of having a licence sold with every computer and it is time we worked towards the idea of this law being strictly enforced.

No, this one will not go down easily. People hate being monitored, being licensed, being checked up on, given permission, but I'm not really worried about ordinary people: I'm worried about the Home Office.

As things stand, some people realise that the computer is coming into our lives as fast as the car did. Possibly much faster, although we won't really know that until today's primitive toys give way to real computers, capable of recalling apparently trivial facts stored in a totally different context a year or two before.

Real computers make a mockery of the idea that we have a right to privacy. One might as well talk of a right to walk the streets; try it and see what the next juggernaut driver says. We give up certain rights in exchange for our toys. Afterwards, we may regret the bargain but with the phone and the computer, the price paid is privacy.

If we can't have privacy, we ought to see what it is that makes privacy precious and try a substitute.

One thing that makes privacy precious is that nobody can go around telling our friends what we do, if we 'keep ourselves to ourselves'. They can imply, cast slurs, refer sarcastically to the goat-skin rug with padlocks but nobody need believe them and we can go on painting daffodils red and spreading the *Collected Works of Paul Neil Milne Johnston* on the floor of the larder, without anybody knowing. And people forget.

Computers don't; you may not remember entering in your computer diary the observation that 'the Joneses have just installed central heating' but the hardware will. It probably won't realise that you didn't mean it at the time but were referring to the amount of brandy consumed at the party the Jonses threw; two year later. you may have forgotten. When, therefore, the Joneses install central heating, your computer will, if you ask it how their home is heated, say, 'They installed central heating two year ago' and you, trusting the machine more than your memory, will ask them if they've gone potty.

The Home Office, however, believes that all records are secret. If I may quote the person who set up the Australian Special Branch (and got chucked out of Australia by an enraged Government, for a system which was a lot less prying than the UK's system): 'If a chap doesn't want a file kept on him, then he's got something to hide and I'd say that is exactly the sort of chap you ought to have a file on.' We certainly ought to have a file on the Home Office.

If, one day, we should get such a law, I know exactly what the Home Office will do.

In its customary, paranoid, megalomanic belief that only employees of the Home Office are to be trusted with false facts about those of us not qualified to be in the Home Office, the Home Office will secretly tell its employees that they may have a personal computer allowance. And clerks will be encouraged to make themselves 'more efficient' by keeping personal facts in a personal computer. Personal facts will be such things as you and me installing central heating, or failing to pay for something we didn't buy, or attending a Home Office Bashing Meeting, or Writing Rude Things in *PCW* About the Home Office in a Subversive Tone, or whatever. And there won't be an 'official file' on you and no record of the 'personal' computer which actually holds it.

Just to enhance your paranoia, the Metropolitan Police is rumoured to be starting up a Personal Computer Users' Club, meetings of which will *not* be open to the public. . . .

Auntie's choice

The BBC is planning to broadcast software for computers. This breakthrough, scheduled for January 1982, is part of the planned series on 'teach yourself computers' which you have already heard about in this column, in which the battles between the various possible suppliers of the BBC computer were analysed.

One of the most prominent rejects for the job of supplying the micro was Clive Sinclair, who is hopping mad. He felt his new ZX81 would have been an ideal tutorial machine, because of its very friendly Basic, which will not let you make a programming error.

Enough has been said about the irrational (or otherwise) aspects of the decision and it may be that many people now have the impression that the selection of the Acorn machine — not the Atom, but the Proton in a second incarnation — was based mainly on an official dislike of Clive himself. I don't think that is true.

Looking at the official specifications of the BBC machine, it is apparent that it is better suited to the plans that the BBC is making for the programmes that will be seen on telly.

For example, it will have ultra high resolution graphics to a standard, with 640 horizontal points, which is not thought to be available on any other machine costing less than £1000 — there will be graphics in seven colours at a lower (but still high at 160 horizontal points) level of resolution. The computer can also be networked with the aid of another add-on facility to other machines, so as to give each user access to a central disk or print facility.' So says the official BBC handout.

All that sounds a lot more like the Proton than the ZX81. The networking facility is recognisable as Acorn's Econet, which was still to be proved in the field at the time of writing but already a real, credible product, and very important in schools or other classrooms (where the programs and programmes are certain to be used).

One of the most important points about the BBC micro will be its ability to LOAD itself from Ceefax — the binary data which the BBC broadcasts in between frames of video. With very little adjustment, the BBC can in fact broadcast a whole 625 lines of Ceefax-type data which would be a big program loaded in a flash. Here, the Atom is already based on a compatible screen size and the ZX80 family would need to be developed.

From the BBC's point of view, this must be a big boost

After the floppy disk, the floppy computers: this one is in fact a cake donated to Intertec by users of its Superbrain and Compustar systems, in Denver Colorado. The user group calls itself Superstar and details are available from 3722 Chestnut Place, Denver Colorado 80216; tel (803) 623 7973.

to Ceefax — the existence of a big-selling micro which can receive software through the broadcast network must make its chance of selling Ceefax that much better.

The only thing which isn't clear is how many machines may be sold. This may be very important and it was Clive's most powerful card to play in the battle.

The standard model is expected (intended) to cost less than £200, including a nice keyboard and 16 kbytes of memory, and the Ceefax add-on is intended to cost £100 or so extra. There will also be another add-on to get data out of the Prestel databanks which British Telecom has inherited from its previous incarnation, Post Office Telecommunications, and which go down the phone lines.

It is also possible to upgrade the standard model — according to the BBC, up to 96 kbytes of memory and disks and printer — into a business system.

It's hard to know what to expect. Sinclair's ZX80 (and now ZX81) sells at the rate of 10,000 per month but is considerably cheaper. On the other hand, the 2000 per month models of the Acorn Atom which are now sold don't keep up with the possible demand and I get angry letters from would-be buyers complaining about delays. Quite how many could be sold, and how many of these are expanded to the £200 price level, is anybody's guess and I gather the BBC guesses it will sell 12,000. Frankly, with publicity given on TV, advertising in the *Radio Times*, and general interest in computers, it could easily be ten times that figure before a year is out and, in that case, I simply don't believe that one company is capable of churning out enough.

Clive's claim to a stake in the project was on two grounds: first, that ZX80 Basic was the easiest for a beginner to grasp; and second, that he was the best micro-maker at getting huge production volumes through a factory. It may be a good idea if he and Tangerine (another company theoretically capable of putting high volume through) are allowed to make the BBC machine under licence. I honestly don't think there is the least danger of making too many.

Sinclair does it again

By the time you read this, there will be more Sinclair computers around than PETs. A fine time to kill the Sinclair ZX80 stone dead, you may think, by launching the ZX81.

Naturally, it isn't as simple as that. The new machine may be cheaper than the old (£70 instead of £100) and it may be prettier (black instead of white) and it may be a lot better at Basic, having finally learned about fractions and mathematics and it may be a lot easier to use (with extra features such as one to see if a key is being pressed) and, most important of all, it may even have overcome that irritating flicker. . . but really, it has killed the MicroAce stone dead. The flicker on the Sinclair, for those who don't have one, was caused by the fact that the computer chip had to stop its ceaseless and remorseless generation of a television image every time the machine's owner pressed a key on that keyboard. It had to recognise the key and decide what to do about it before coming back to the video display and finding the frame synch had gone out of synch.

The new machine normally runs a lot slower than the old ZX80. This is because it has a lot more to do and because it keeps rushing off from whatever program it may be running to make sure that the screen image is being generated.

The new machine can, however, run around the same speed as the old if it is given the Basic instruction FAST — then it forgets all about the screen until either it is told NORMAL, or it finishes processing and returns to command mode.

Of new instructions, there are quite a few. The one I'm most pleased to see is INKEY$ which is not a dollar with a smudge, but a single character string read from the keyboard.

The INKEY$ instruction makes it possible for people who don't have a good grasp of Z80 machine code to get information from the keyboard without stopping the program with an INPUT statement. On the screen, say, a Klingon war cruiser is nearly centred in the cross-hairs of your pilot's attack brig and naturally darts away to the left but the pilot quickly shifts his fingers on the controls, steers the craft back onto target and POW (or, more prosaically, a string of numbers races past, fast if you press the number 9, slowing down as you get near the one you want by moving to 6 or 5, and finally creeping along at one a second, when you press the number 1). You can't do that in most Basics, except on the Tandy TRS-80 and its INKEY$ instruction has the drawback that you can only use it once. No matter how long you hold it down, it won't repeat but the Sinclair INKEY$ will spout a fountain of key codes and your software can check to see if the key has been kept down, or has been lifted and pressed again.

No doubt people will fuss about the appearance of

Sinclair's £70 ZX81 and its £50 printer — see 'Sinclair does it again'

graphics with a PLOT statement and an UNPLOT to match it but frankly, with only 64 by 44 pixels, this won't give the world much more than Android Nim and a few histograms, and, prettier chess pieces.

Inside the machine, the first thing you notice is that 18 of the chips that were in the ZX80 have vanished and in their place in the ZX81 is a single, big, Ferranti-built special. That chip, built in a technology called collector diffusion isolation, is important because it cuts the number of chips down, which cuts the amount of work down in making it. More to the point, it is not going to be a simple job copying it.

Last year, the Barnet-based Comp Shop was able to study the ZX80 and have an imitation ready to market almost before Clive had the original available — because all that was really needed was to reproduce the ROM chip which understood Basic. And the Barnet Mafia, as they have come to be called, could do that quicker than Uncle Clive could.

It is worth remembering that Sinclair is rumoured to have got something like £10,000 or £15,000 cash from Chris Cary of Comp, when they signed a deal giving the Cary MicroAce the US kit market; and it will be remembered, too, that the Cambridge Cosa Nostra (as Clive himself phrased it at the time) commented, 'We mustn't waste time arguing in the courts — this product is a nine months' wonder and we have to use every month.' That was nine months ago.

Apart from preventing copying, the big chip improves tape recording quality. The Ferranti chip process is almost unique in semiconductor circles in that CDI is just as good at producing linear circuits (amplifiers) as digital (switches). Clive has included automatic amplifiers in the design. The software for tape handling has also been improved and now the machine will actually look along the tape for the right program, by name.

The other thing that one notices, inside the case, is a bigger radiator fan. Sinclair still insists that the number of people who suffer from overheating on the ZX80 was very small and the problem was almost certainly due to faults in chips but the legend that odd failures can be cured by putting the machine in the fridge or standing a carton of ice cream on the case has taken hold. A bigger chunk of metal under the voltage regulator may only work on user psychology but it will also dissipate heat a bit better, even if that isn't truly necessary. So that's a good move. As a bonus, the printer has been announced — at £50.

The photograph shows that nobody is going to use it (when it appears on schedule in June) for sending typescript to the printers, or for preparing company reports. It works on the principle of taking silvered paper and vaporising the aluminium with a spark, disclosing black paper underneath. This may be quite legible but it'll never replace the typewriter.

The design is new, by the way. Most printers using electrosensitive paper have some kind of wire matrix to scrape the paper, sparking away at the black points. This one has a single point, which scans like the electronic beam in a television. It is on a band, and when it reaches the edge of the paper, it passes round behind and a second point starts on the next line of the letter matrix immediately.

The new memory chip controls the printer, too, and all its facilities can be plugged into the old ZX80 (all except flicker-free graphics and better tape amplification) for £20 including a new keyboard overlay.

Nothing about the new computer gives the slightest hint of the fact that Clive has produced a new type of television screen around which he will be building a £50 television set to go in your pocket next year. The screen attracted much more attention in the world's press than

the computer, despite the fact that it was the computer which gave Clive the money to develop his screen from the point where the National Enterprise Board told him to take it away because there was no future in flat television screens in the UK.

The flat Sinclair screen is minuscule and will almost certainly not be used for computers without a lens in front of it, either as a magnifying glass or as a projection lens, because even the amazing Scrumpi computer produced two years ago by the late John Miller Kirkpatrick, given 12 characters per line, wouldn't have been legible on this. By the time a bigger version is available for computer output use, computers will have changed so much that it's pointless to guess what Sinclair will do with it. He agrees that it obviously has a computer application, because it uses so little power that it can be run off dry batteries.

Finally, software. Clive has released his first few cassettes of ZX80 programs: games, junior education, business and household and programmers' aids. At around £3 per cassette with six or seven programs per tape, the quality is superb but when one looks at the Game of Life, for instance (it's a very nice game of Life) and compares its 400-odd cell screen with the thousands of cells on the Acorn Atom Life, one does realise that the ZX80 isn't in the same market as any other machine available. Then again, at £70 to get started, who cares?

Ever since we first printed a picture of this printer without a keyboard, readers have clamoured for more details. This is the biggest keyboard so far on the Weyfringe, so we're printing it again. Details of the Century KSR II on 0642 470121.

Distant relations

Nobody would believe me if I went into print saying how sorry I was to 'lose' Kit Spencer of Commodore who's just got a new job, in charge of PET sales in 'the rest of Europe' — that is, not Britain and not Germany. He is now sales boss for Commodore Electronics and letters complaining about the unfair treatment of Commodore will now have to be written by his colleague Bob Gleadow.

When any product sells as well as the PET has done, it attracts attention and criticism. Not all the criticism is fair but it deserves to be reported, just in case — after all, how can a journalist tell which retailers have found a genuine problem and which are just griping? So it's easy to see why a committed pro-company executive like Spencer should occasionally have to be dragged into a restaurant by mutual friends and publicity agents in order to try and 'get to know Guy Kewney better'.

In my own defence, it should be said that time has proved a lot of criticism which was reported was justified. Kit Spencer never could accept this (his loyalty to Commodore isn't any half-hearted affair), with the result that I often found myself reluctant to accept his statements as objective evidence.

Never mind; it has always struck me that we ought to get on — after all we have a large number of mutual friends who seem to actually like both of us. Perhaps all we needed was for the circumstances to be right — like, for instance, Kit over in Switzerland selling into a different market, and me over here in London, with neither of us required to listen to a word the other says.

Joy of chess

Philip Joy has written a chess program for the ZX80. It costs £10 and needs the 16 kbyte add-on memory. You play it at three levels: 'Beginner', which spends around 20 seconds thinking and by all accounts doesn't get further than checking for attack; 'Standard', which spends almost twice as long and actually looks for the consequences of its moves; and 'Advanced', which can spend two minutes looking two moves ahead. Details from 130 Rush Green Road, Romford, Essex RM7 8QA.

Bob's booty

Anyone need £¼ million? If Bob Smith likes you and your ideas, that is what you can have. Bob Smith was once the boss of Newbury; he now works for Grundy Terminals, and has been told to use his own judgement in selecting good ideas in computers and electronics and to back them to a maximum of £250,000.

In his own words: 'Any decision to back somebody will be based equally on the technical merits of the project and intuition about the person's ability to run a company.' The ideas, he says, will be British and may come from universities, individuals, or from existing companies.

His first project will be a new hard copy graphics terminal. Then, in the pipeline, he forecasts a new single board microprocessor, with 'unique design facilities'.

Two other points worth highlighting: Smith has electronic plant available within his Electronics Division of Grundy, together with administrative support (he is prepared to buy your company with you if he likes it), and second, he has an American outlet through Grundy's US subsidiary which is called Grundy Environmental Systems, in San Diego.

Details on 01-977 1177.

Atom magic

Acorn has recommended a useful book as a supplement to the rather scholarly manual normally supplied with the Atom microcomputer. The useful book — *The Acorn Atom Magic Book* — is printed entirely independently by Timedata.

What makes it worth recommending is that it supplies a lot more than the normal collection of funny programs (from biorhythm to lunar lander) that inevitably emerge from users soon after a machine becomes popular. It also includes programming hints.

For example, one of the nicer things about the Atom's method of saving programs or data onto a cassette tape is the way you can see what is going through the system and control what happens. The book, enlarging on the standard manual, gives the way to save a program in order to be able to load it and RUN it automatically and how to have one program actually load and run a second program from tape. Again, the Atom has by far the best system of allowing the user to put assembler language instructions into programs; the book goes further and shows ways of putting Basic routines (such as the generation of random numbers) into assembler programs. There is also a little routine to notice a single key pressed on the keyboard (you don't have to hit 'return') and a way round a minor bug in the FOR. . . NEXT statement in Basic. Most important, there is a really useful section on how to convert more standard versions of Basic into Atom Basic.

Why's Guy cross?

People living in the Bristol area are reciving a monthly newsletter — actually a self-advertising sales sheet — from a company which sells Apples. The company is Datalink Microcomputer Systems and it uses its monthly newsletter to notify customers of new hardware and software developments, such as the

The first answer to 'who needs the Apple III?' seems to be coming in now and it is: 'Users of the Apple II who are hooked on the Apple, but want a bigger machine.' That makes sense, I suppose. Microsense just finished a series of seminars to familiarise its agents with the machine and that is the gist of what was said. Details 0442 48151.

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COMPATIBLE

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A NASCOM-2 BASED SYSTEM FOR £1549 + VAT

The proven Nascom-2 microcomputer can now be bought as a complete system from £1499 + VAT. For this price you get the Nascom-2 kit, 16K RAM board kit, Kenilworth case with 2 card frame, Centronics 737 printer, 10 inch monitor, and the Gemini Dual Drive Floppy Disk System. The CPU and RAM boards are also available built – the additional cost is available on application.

GEMINI G805 FLOPPY DISK SYSTEM FOR NASCOM-1 & 2

It's here at last. A floppy disk system and CP/M.

CP/M SYSTEM. The disk unit comes fully assembled complete with one or two 5¼" drives (FD250 double sided, single density) giving 160K per drive, controller card, power supply, interconnects from Nascom-1 or 2 to the FDC card and a second interconnect from the FDC card to two drives, CP/M 1.4 on diskette plus manual, a BIOS EPROM and new N2MD PROM. All in a stylish enclosure.

Nascom-2 Single drive system. **£450 + VAT**
Nascom-2 Double drive system **£640 + VAT**
Nascom-1 Single drive system. **£460 + VAT**
Nascom-1 Double drive system **£650 + VAT**
Additional FD250 drives ..... **£205 + VAT**

D-DOS SYSTEM. The disk unit is also available without CP/M to enable existing Nas-Sys software to be used. Simple read, write routines are supplied in EPROM. The unit plugs straight into the Nascom PIO.

Single drive system ..... **£395 + VAT**
(please state which Nascom the unit is for)
Certain parts of the CP/M and D-DOS disk systems are available in kit form.
Details available on request.

KENILWORTH CASE FOR NASCOM-2

The Kenilworth case is a professional case designed specifically for the Nascom-2 and up to four additional 8" x 8" cards. It has hardwood side panels and a plastic coated steel base and cover. A fully cut back panel will accept a fan, UHF and video connectors and up to 8 D-type connectors. The basic case accepts the N2 board, PSU and keyboard. Optional support kits are available for 2 and 5 card expansion.

Kenilworth case ..... **£49.50 + VAT**
2-card support kit ..... **£7.50 + VAT**
5-card support kit ..... **£19.50 + VAT**

GEMINI EPROM BOARD

This Nasbus compatible EPROM board accepts up to 16, 2716 or 2708 EPROMs it has a separate socket for the MK36271 8K BASIC ROM for the benefit of Nascom-1 users. And for Nascom-2 users, a wait state for slower EPROMs. The board also supports the Nascom Page Mode Scheme.

EPROM Board (kit)..... **£55 + VAT**
EPROM Board (built & tested)..... **£70 + VAT**

CASSETTE ENHANCING UNIT

The Castle interface is a built and tested add-on unit which lifts the Nascom-2 into the class of the fully professional computer. It mutes spurious output from cassette recorder switching, adds motor control facilities, automatically switches output between cassette and printer, simplifies 2400 baud cassette operating and provides true RS232 handshake.

Castle Interface Unit ..... **£17.50 + VAT**

A-D CONVERTER

For really interesting and useful interactions with the 'outside world' the Milham analogue to digital converter is a must. This 8-bit converter is multiplexed between four channels – all software selectable. Sampling rate is 4KHz. Sensitivity is adjustable. Typical applications include temperature measurement, voice analysis, joystick tracking and voltage measurement. It is supplied built and tested with extensive software and easy connection to the Nascom PIO.

Milham A-D Converter (built and tested).... **£49.50 + VAT**

PROGRAMMER'S AID

For Nascom ROM BASIC running under Nas-Sys. Supplied in 2 x 2708 EPROMs. Features include: auto line numbering; intelligent renumbering; program appending; line deletion; hexadecimal conversion; recompression of reserved words; auto repeat; and printer handshake routines. When ordering please state whether this is to be used with Nas-Sys 1 or 3. **Price £28 + VAT.**

DUAL MONITOR BOARD

A piggy-back board that allows N1 users to switch rapidly between two separate operating systems. **Price (kit) £6.50 + VAT.**

NASCOM-2 Microcomputer Kit **£225 + VAT**
NASCOM-1 Microcomputer Kit **£125 + VAT**
Built & tested **£140 + VAT**
IMP Printer. Built & tested..... **£325 + VAT**

CENTRONICS 737 MICRO PRINTER

A high performance, low price, dot-matrix printer that runs at 80cps (proportional) and 50cps (monospaced). This new printer gives text processing quality print. And can print subscripts and superscripts. It has 3-way paper handling and parallel interface as standard. Serial interface is optional. **Price £425 + VAT.** Fanfold paper (2000 sheets) **£18 + VAT.**

GEMINI 'SUPERMUM'

12 x 8 piggy-back board for Nascom-1 offering five-slot motherboard, quality 5A power supply and reliable buffering with reset jump facility. **Price £85 + VAT.**

BITS & PC's PCG

5 x 4 board which plugs straight into Nascom-2. Operates on cell structure of 128 dots, producing 64 different cells. Once defined, each cell may be placed anywhere, any number of times on screen simultaneously. Max screen capacity: 768 cells. Dot resolution: 384 x 256 = 98304. Many other features including intermixing of alpha-numeric characters and pixels. **Price (kit) £60 + VAT.**

GEMINI 64K RAM BOARD

Newly developed Nasbus compatible board that can accommodate up to 64K of RAM including Page Mode facility. **Prices: £110 (16K), £130 (32K), £150 (48K), £170 (64K). Add VAT to all prices.**

All prices are correct at time of going to press and are effective 1st May 1981.

DISKPEN

The powerful text editor written for the Nascom is now available on a 5¼ inch floppy disk with a number of new features. **Price £43.25 + VAT.**

PORT PROBE

Allows monitoring of input and output of Nascom PIO. This board can generate interrupts and simulate handshake control. **Price (kit) £17.50 + VAT.**

HEX & CONTROL KEYPADS

Hexadecimal scratchpad keyboard kit for N1/2: **Price £34 + VAT.**
As above but including (on the same board) a control keypad kit to add N2 control keys to N1. **Price £40.50 + VAT.**

BASIC PROGRAMMER'S AID

Supplied on tape for N1/2 running Nas-Sys and Nascom ROM BASIC. Features include auto line number, full cross-reference listing, delete lines, find, compacting command, plus a comprehensive line re-numbering facility. **Price £13 + VAT.**

GEMINI EPROM-PROG.

2708 (multi-rail) and 2716 (single-rail) EPROM programmer kit controlled by N1/2 PIO. Supplied with comprehensive software for use with Nas-Sys. **Price £35.95 + VAT.**

WE STOCK Nasbus COMPATIBLE COMPUTER PRODUCTS

All the products are available while stocks last from the Nascom dealers below.
(Mail order enquirers should telephone for delivery dates and post and packing costs.) Access & Barclaycard welcome.

BITS & PC'S
4 Westgate, Wetherby, W. Yorks.
Tel: (0937) 63774.

BUSINESS & LEISURE MICROCOMPUTERS
16 The Square, Kenilworth, Warks.
Tel: (0926) 512127.

ELECTROVALUE LTD.
680 Burnage Lane, Burnage, Manchester M19 1NA.
Tel: (061) 432 4945.
28 St Judes, Englefield Green, Egham, Surrey TW20 0HB.
Tel: (0784) 33603. Tlx: 264475.

TARGET ELECTRONICS
16 Cherry Lane, Bristol BS1 3NG.
Tel: (0272) 421196.

INTERFACE COMPONENTS LTD.
Oakfield Corner, Sycamore Road, Amersham, Bucks.
Tel: (02403) 22307. Tlx: 837788.

HENRY'S RADIO
404 Edgware Road, London W2.
Tel: (01) 402 6822.
Tlx: 262284 (quote ref: 1400).

latest 'special discount' offer from Apple to schools (20 percent off until 29 May) through dealers. Careful readers will have noticed that the compiler of 'Newsprint' (me) is credited as being 'Editor of *Datalink*' and most of you will recognise that as a reference to a weekly news and features magazine for programmers. However, writing down 'Datalink Microcomputer Systems Limited Monthly Newsletter' in small print like that doesn't quite do justice to the actual presentation of the newsletter printed in Bristol. It actually has the word DATALINK in *enormous* letters, then (microcomputer systems ltd) in teensy weeny ones with the address and phone number and under DATALINK, in almost as enormous letters, the words MONTHLY NEWSLETTER. Anybody getting this sales sheet might be forgiven for thinking that *Datalink Monthly Newsletter* was the title and that it might be *Datalink*.

The bosses of Datalink Microsystems Ltd (or DML) can call their company what they like. But when it comes to a newsletter, then it is only fair to make it clear to the people who get that letter that is not an unbiased news sheet, but a hard-sell, 'we-are-the-greatest' promotion giveaway.

And since there actually is a real newspaper called *Datalink* and people in the micro business know it exists, I think it would be ethical of DML to make some effort to dispel any possible confusion. Forgive my scepticism, but the impression given by the sales leaflet actually is the opposite. Perhaps it doesn't matter much — local shopkeepers use all kinds of little tricks to lure customers in through the doors and in the end what matters is what kind of service the customers get.

Nascom Pascal

The nicest thing about understanding Basic is that you are qualified to learn Pascal, a programming language with much more prestige attached to knowing it. Not content with wanting to write programs in Pascal, a group of Nascom owners is planning to write a Pascal compiler.

This is probably the single bit of news which can be regarded as good for the unhappy group of people who are seriously trying to do things with Nascom hardware. At press time, the company was still bust and still making about a third of the number of computers that it could sell, if dealers quoted in the user club newsletter are to be believed. Increasingly, people speak of Nascom in the past tense and what is needed for the survival of this machine is some hope, which could come in two forms.

One would be for the receiver to find a buyer, agree a price and for both parties to stick to it.

Failing that, the next best thing would, ironically, be for the company finally to be wound up. This would free the six dealers and distributors who are already producing add-ons to start producing imitation Nascom 1 and Nascom 2 boards and, more important, to start designing Nascom 3. Because (at the risk of jeopardising my own immense personal popularity with Nascom users) it has to be said that both Nascom 1 and Nascom 2 are starting to look a trifle old and costly. Compared with the new colour, packaged systems like Commodore's VIC, the Atari machines due out in June, Acorn's Proton and next year's BBC machine, not to mention any number of packaged systems closer in design to the Nascom itself (such as John Marshall's own Gemini, if he ever gets the board right).

A similar board, software compatible with Nascom, would seem too great a risk if Nascom itself were known to be working in the same direction and its refusal either to live or die is casting a cloud on the market. So the development of something future-looking like Pascal means that anyone planning a Nascom-like Mark III can look to enthusiastic users.

Intriguingly, the new Pascal looks as though it will be free. The latest edition of the *INMC* news magazine (modestly described as September 1980/January 1981) suggests those interested should contact Rory O'Farrell, Tinode, Blessington, Co Wicklow, Eire. (He won't thank you for expecting him to pay postage on all replies, so send stamps and envelopes.)

He plans to put the compiler in the club program library. The idea is to start from existing developments, which seem not to include either possible standard of Pascal, UCSD or ISO.

Meanwhile, all I have to do is work out whether the gratuitous insult of the *INMC* gossip column (it purports to be written by someone called 'Guy Klueless') is sufficiently counterbalanced by the inherent flattery. Well, it is kinda nice to be thought famous and if you don't make any enemies, you probably haven't done anything, either.

Atomic egg

Okay, okay, I have egg on my face again. There *is* a user club for Acorn Atom users and I should have known about it, and I should have joined. If you are interested, it costs £4, and is run by R G Meredith, Sheerwater, Yealm View Road, Newton Ferrers, South Devon. You don't have to have an Atom.

PET protection

Overcoming one of the worst problems in writing programs is not so much a question of getting the programs to run, as getting them to sell. Three major problems here, according to Drive Technology, are the slowness of programs written for interpreted Basic, the cramped amount of memory available and the problem of having the program ripped off by a rival vendor and sold for half the price.

Drive Technology thinks that a Basic compiler for the PET will solve these problems.

Compiling, the company observes, produces much faster-running code than interpreting Basic statements and its own compiler runs between ten to 20 times faster than the Basic on Commodore's PET. The compiler also produces code which occupies about half as much memory, allowing longer programs to be written.

Where DTL thinks it has been particularly clever is in making the output of the compiler workable only on specially formatted disks. Stitched into the output of the compiler is an identity code for the retailer who sells it. The program, says DTL, 'will not run on disks other than the protected disks supplied to the vendor'. And, they add, even if attempts are made to create a copy of a protected disk, by copying sector by sector, this will not work. 'This is because information is contained within sectors that give errors when read. The information can only be read by knowing the correct key and by having the subroutines to use it.'

The Basic compiler is available for the price of £300 for the ordinary compiler and £900 for the compiler that includes the protection tricks. The protection facility, says DTL, allows the seller to recoup the extra cost after 'only a few sales'.

Both bits of software are for PET computers, both 40 column and 80 column models. Details from 318 Ringwood Road, Ferndown, Dorset, tel 020264 5819.

How do they do it?

Surely it comes as no surprise to find that £5000 'can now buy a complete full-scale Z80 business micro with 64 kbytes memory, half a megabyte of floppy disk storage, screen, keyboard, printer, and word processing software'?

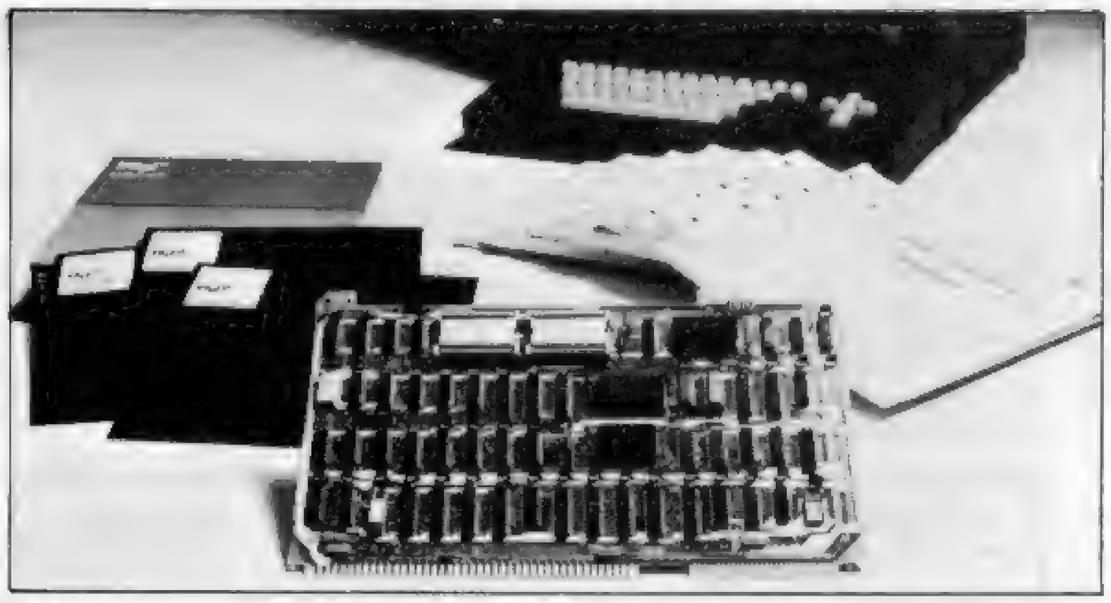
The marvel described above, from Memory Computers, includes a printer worth £400, so what you get for your money must be the video display, offering 40, or 80, or 120 characters per line. The £5000 price is £700 down on the old one. Hooray! Details on 01-445 6614.

Apple eye

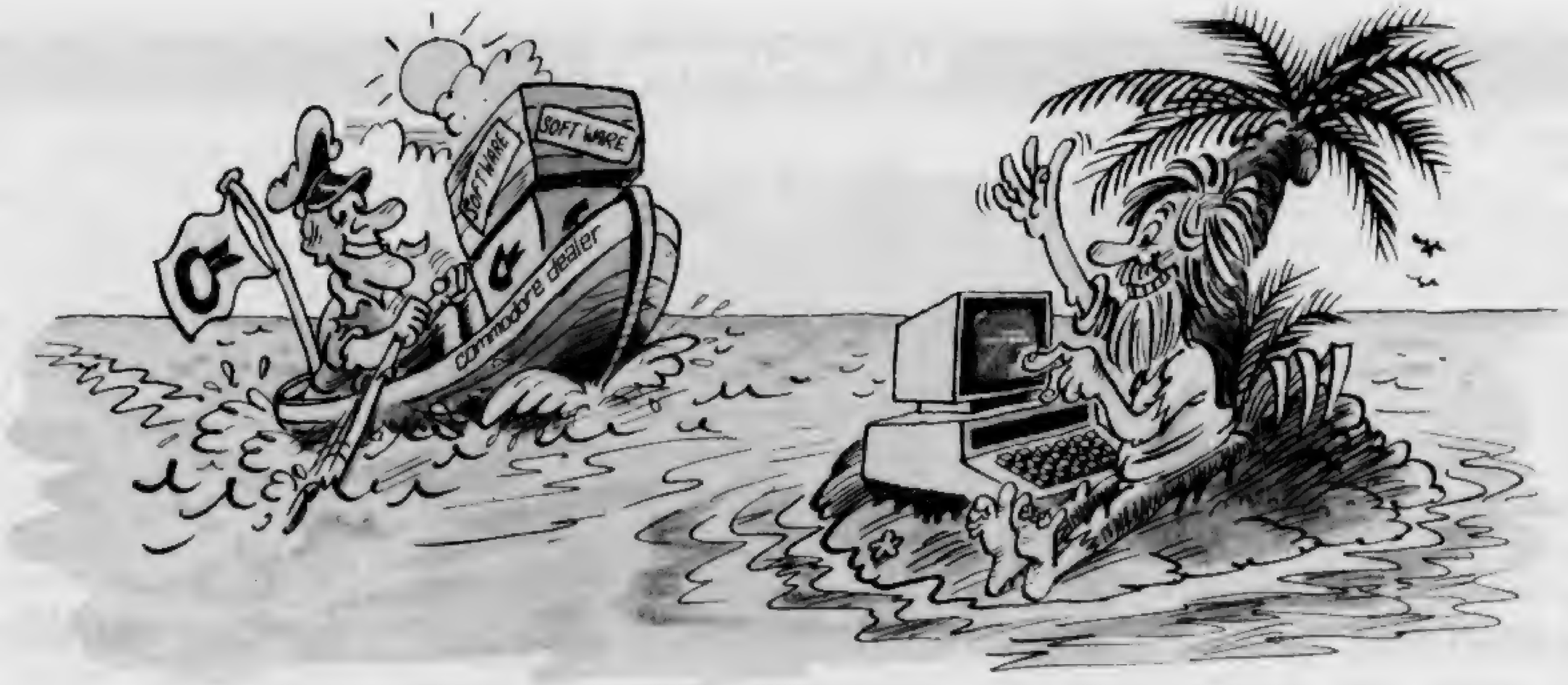
A startling new product from Bill Unsworth's company, U-Microcomputers, gives an Apple the ability to see.

It assumes you have a video camera; it takes the electrical signals from the camera and feeds them into the high resolution graphics of the Apple memory. There, theoretically, you can start doing pattern recognition.

And, theoretically, that would allow the Apple to read (words on a piece of paper held in front of the camera) and, with clever soft-



The cleverest thing about this iAPX 432 (it's a 32-bit micro) from Intel is the way it is to be programmed. No more assembler, Basic, Cobol or Fortran, says Intel; instead, you manipulate 'objects' of code through the newest, trendiest programming language, Ada. It may well be clever for all the reasons that Intel says but the cleverest thing is that nobody has ever heard of objects and will have to study the iAPX 432 to find out about them. No rush though; it will be at least two years before anybody outside a few development companies can get one to develop software on and many years before we see it in the shops.



You're never alone with a Commodore PET

If you buy just any make of microcomputer you could find yourself on your own. And that's serious. Because without first class software and support, all you're left with is a box of wires.

On the other hand, when you buy Europe's No.1 microcomputer, the Commodore PET, you have access to the largest and finest range of software in the UK today; the most experienced dealer network; 24 hour field maintenance service; plus our very own training courses and user's club – all to ensure that you get the best from your system.

But how can Commodore offer so much? Well, we've been in the high technology business for over 20 years, whereas many of our competitors have just started out. We even manufacture the silicon chips for other microcomputers. This enables us to keep our costs to you down, so you can buy a self-contained PET for £450, or a complete business system from as little as £2,000 (+ VAT).

Of course, you could buy a box of wires for about the same price. But all you'll get from our dealers is sympathy.

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Advanced Management Systems, EC2, 01-638 9319
C.S.S. (Business Equipment) Ltd, E8, 01-254 9293
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Computer Sales & Software Centre Ltd, ILFORD, 01-554 3344
Cream Computer Shop, HARROW, 01-863 0833
Da Vinci Computer Shop, EDGWARE, 01-952 0526
Henderson Bennett, SE25, 01-654 5609
Home and Business Computers, E12, 01-472 5107
L & J Computers, NW9, 01-204 7525
Logic Box Ltd, SW1, 01-222 1122
Merchant Systems Ltd, EC4, 01-353 1464
Micro Computer Centre, SW14, 01-878 7044
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Amplicon Micro Systems Ltd, BRIGHTON, 562163
T & V Johnson (Microcomputers Etc) Ltd, CAMBERLEY, 20446
Cambridge Computer Store, CAMBRIDGE, 65334
Wego Computers Ltd, CATERHAM, 49235
Dataview Ltd, COLCHESTER, 78811
Amplicon Micro Systems Ltd, CRAWLEY, 26493
S.M.G. Microcomputers, GRAVESEND, 55813
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Commonsense Business Systems Ltd, HIGH WYCOMBE, 40116
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T & V Johnson (Microcomputers Etc) Ltd, OXFORD, 721461
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Slough Microshop, SLOUGH, 72470
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Super-Vision, SOUTHAMPTON, 774023
Symtec Systems Ltd, SOUTHAMPTON, 38868
Stuart R Dean Ltd, SOUTHEND-ON-SEA, 62707
The Computer Room, TUNBRIDGE WELLS, 41644
Orchard Computer Services, WALLINGFORD, 35529
Photo Acoustics Ltd, WATFORD, 40698
Microchips, WINCHESTER 68085
P.P.M. Ltd, WOKING, 80111
Petalect Electronic Services Ltd, WOKING, 69032
Oxford Computer Systems, WOODSTOCK, 812838

MIDLANDS & S. HUMBERSIDE

C.B.S. Consultants, BIRMINGHAM, 772 8181
Computer Services Midlands Ltd, BIRMINGHAM, 382 4171
Marchant Business Systems Ltd, BIRMINGHAM, 706 8232
Micro Associates, BIRMINGHAM, 328 4574
Peach Data Services Ltd, BURTON-ON-TRENT, 44968
Jondane Associates Ltd, COVENTRY, 664400
Davidson-Richards Ltd, DERBY, 366803
Allen Computers, GRIMSBY, 40568
Caddis Computer Systems Ltd, HINCKLEY, 613544
Machsize Ltd, LEAMINGTON SPA, 312542
Arden Data Processing, LEICESTER, 22255
Roger Clark Business Systems Ltd, LEICESTER, 20455
Lowe Electronics, MATLOCK, 2817
A.J.R. Office Equipment Services Ltd, NOTTINGHAM, 206647
Betos (Systems) Ltd, NOTTINGHAM, 48108
PEG Associates (Computer Systems Ltd), RUGBY, 65756
Walters Computer Systems Ltd, STOURBRIDGE, 70811
System Micros Ltd, TELFORD, 460214

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Ackroyd Typewriter & Adding Machine Co. Ltd, BRADFORD, 31835
Microprocessor Services, HULL, 23146
Holdene Ltd, LEEDS, 459459
South Midlands Communications Ltd, LEEDS, 782326
Yorkshire Electronics Services Ltd, MORLEY, 522181
Computer Centre (Sheffield) Ltd, SHEFFIELD, 53519
Hallam Computer Systems, SHEFFIELD, 663125
Holbrook Business Systems Ltd, SHEFFIELD, 484466

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Elfton Ltd, HARTLEPOOL, 61770
Dyson Instruments, HETTON, 260452
Fiddes Marketing Ltd, NEWCASTLE, 815157
Format Micro Centre, NEWCASTLE 21093
Intex Datalog Ltd, STOCKTON-ON-TEES, 781193

S. WALES & WEST COUNTRY

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C.S.S. (Bristol) Ltd, BRISTOL, 779452
T & V Johnson (Microcomputers Etc) Ltd, BRISTOL, 422061
Sumlock Tabdown Ltd, BRISTOL, 276685
Sigma Systems Ltd, CARDIFF, 34869
Reeves Computers Ltd, CARMARTHEN, 32441
A.C. Systems, EXETER, 71718
Milequip Ltd, GLOUCESTER, 411010
Jeffrey Martin Computer Services Ltd, NEWQUAY, 2863
Devon Computers, PAIGNTON, 526303
A.C. Systems, PLYMOUTH, 260861
J.A.D. Integrated Services, PLYMOUTH, 62616
Business Electronics, SOUTHAMPTON, 738248
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LIVERPOOL

Aughton Microsystems Ltd, LIVERPOOL, 548 7788
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Byte Shop Computerland, MANCHESTER, 236 4737
Computastore Limited, MANCHESTER, 832 4761
Cytek (UK) Ltd, MANCHESTER, 872 4682
Executive Reprographic Ltd, MANCHESTER, 228 1637
Professional Computer Services Ltd, OLDHAM, 061-624 4065

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Holdene Microsystems Ltd, EDINBURGH, 668 2727
Gate Microsystems Ltd, GLASGOW, 221 9372
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Thistle Computers (Macmicro), INVERNESS, 712774
Ayrshire Office Computers, KILMARNOCK, 42972
Thistle Computers, KIRKWALL, 3140

N. IRELAND

N. Ireland Computer Centre, HOLLYWOOD, 6548

For further information about Commodore services and products, contact your local dealer, or send off this coupon to obtain our free literature pack.
To: Commodore Information Services, 818 Leigh Road, Slough, Berks. SL1 4BD

03PC1

Name _____

Position _____

Address _____

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Intended application _____

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commodore

This list covers dealers participating in our advertising.

ware, to understand what it saw.

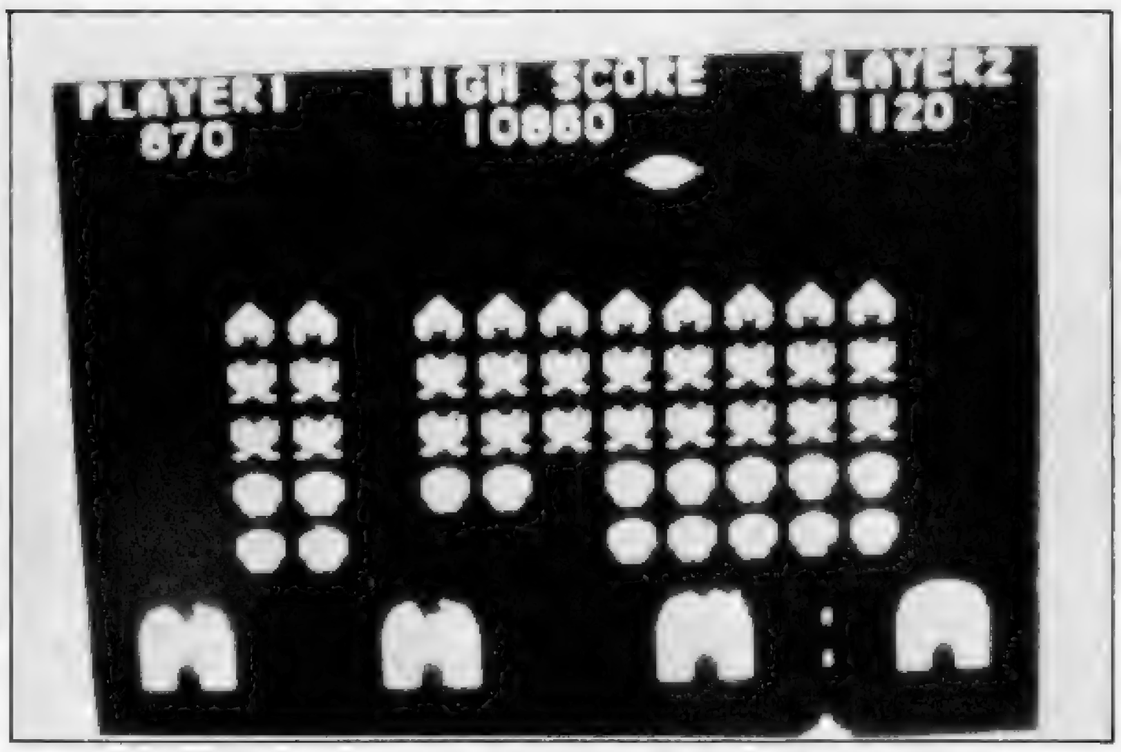
Unsworth offers the intriguing idea that it might be able to read musical scores. If this can be done, of course, it won't be long before some lunatic connects this to the already existing synthesiser boards and the Apple replaces the symphony orchestra as we know it. (Only kidding, but somebody is bound to try it.) The new board, however, only offers 256 by 256 pixels and costs £265. Details from Long Lane, Warrington, Cheshire WA2 8PR.

Learning WP

Yet another piece of software to turn a computer with CP/M into a word processor; this time from Almarc, to run on the Vector Graphic machines which Almarc distributes. The claim is that it is the only word processing system designed to let experts improve on it to suit themselves. Details from David Swain, marketing director, on 0602 625035.

PET show

Commodore has promised 'a new announcement' for its PET Computer Show, 18-20 June. The new program could well be the new video interface computer, VIC, but don't bet too heavily on that, because VIC could easily appear elsewhere first. Certainly, if all goes to plan, VIC will be generally available by the time of the show; but other products are known to be in the pipeline.



New methods of overcoming the now-obsolete ZX80's nasty 'flicker' are becoming available from several sources. Latest is Bug-Byte, a company which also supplies software for the Acorn Atom — the illustration shows Atom Invaders. Most sophisticated game for the ZX80 is a version of breakout, using flicker-free animation (it needs 4 kbytes of memory, costs £6) and the programming course, including cassette, for £9 looks interesting. If I get a chance to review these, I will; catalogue from 251 Henley Road, Coventry CV2 1BX.

Last year, with around 25,000 PETs sold, nearly 9000 visitors came to the show. This year, with 45,000 sold, the Cafe Royal should be crowded — it would be well worthwhile getting a trade ticket somehow and going on the 19th. Exhibitors will include many of the UK and overseas builders of add-on hardware, plus a vast amount of software writers and publishers.

Process control

Put an Apple in a factory and keep it busy monitoring things like temperature and pressure. It's always been theoretically possible: now a new product from Datex Micros has appeared, which makes it theoretically easy. Datex has adapted a remote data acquisition and process control system called REMDACS, made by chip-maker Intersil, for the Apple. This allows up to 500 remote analogue or digital 'stations' (items of equipment for reading meters) to be connected to the Apple II with up to a mile of twin flex. A complete system including 48k Apple, video, controller card, sample programs and documentation costs nearly £2000. Remote cards are under £300 and each card can control 16 digital or analogue channels. That's cheap. Details on 0903 39290.

Disk head cleaning kits (and disk file binders) are being given away free by the Data Recording Products group of 3M and its distributors, to people who buy Scotch Disks. Mind you, I never could buy Scotch recording tape because of a secret conviction that they were sticky. . . .

Basic tape

Any course on programming that doesn't involve using a computer has to work hard to convince me it is worth the money. The new Guild Sound and Vision video course doesn't use a computer. Tell you what: donate *Basic, an Introduction to Computer Programming* to Computer-Town UK and prove me wrong (0733 63122).

Power package

These days, not too many micro users want to build their own systems, so the idea of a five percent discount on power supplies won't seem quite as wonderful as it would have three years ago. You have to buy 20 supplies and, not surprisingly, this applies to members of a bona fide computer club only — who else would want 20 supplies? They come with varying specifications — £29 for an unregulated 8 V at 8 A plus 15 V at 1 A, and minus 8 V at 1 A or £39 for the same supply regulated to plus 5 V, plus 12 V and minus 5 V There's a plus and minus 16 V supply giving 3 A, regulated to plus and minus 12 V at similar prices. And there's big fat 8 V at 10 A which you can have regulated to 5 V, for a bit less. Supplier IMAC will keep this offer open for one month from our publication hitting the streets; phone Newport (IoW) 0983 524393.

Letter quality

All typewriters should be computers, to save money in building time. If Commodore made its new 'letter quality printer' (that is, typewriter) in enough volume, it should be able to make orthodox electric typewriters look ridiculously pricey. As it is, this product starts off at just over £1000 (£995 plus VAT). Compared with anything remotely similar on the market, that's not bad value and it will serve as a terminal for word processing. It isn't all that fast; in fact, at 16 characters per second, it counts as slow. Details from stockists.

Cheap developing

Having laid out a small fortune for a genuine Intel Intellec microcomputer to develop genuine programs for genuine microprocessors, it suddenly dawns on the buyer that there are other micros around and he certainly can't afford another development system. That's why Rapid Recall, which sells genuine Intel development systems, is now selling software which allows the users of those systems to develop software for the Zilog Z80 (and also such micros as the 6502, 6800, F8, 6809) on their genuine Intellecs. It's a lot cheaper just buying a little add-on hardware and software. Details 0494 35634.

Micro muffler

Anybody who has just enough money to buy a computer hasn't actually got enough money to buy a computer because of all the other things he's going to need afterwards — printers, paper for the printers and now, little boxes to put the printer in to stop the noise driving your office colleagues potty. For £80 plus VAT, Bestobel Acoustics has produced a sound-deadening box measuring 18in by 15in by 8in, which the company says reduces noise to acceptable limits. If your printer will fit in the box, details are on 0734 661432.

Amazing Value – compatible with TRS-80 16K level II

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The Video Genie System has many uses in all spheres of life, the easy to use BASIC language means that programs are easily written for specific applications, and pre-recorded program tapes are available in great variety

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The powerful Extended BASIC interpreter makes the solution of complex scientific problems simple, and the graphics allow pictorial displays of results

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COMPETITION

Modern microcomputer technology has many applications, but one where it has so far had little impact is in reducing the problems of disability.
To mark the designation by the United Nations of 1981 as "The International Year of Disabled People", *PCW*, in conjunction with the IYDP Technology Working Group, is holding a competition for the best article on the subject:
"The application of micro-computer technology to the problems of disability".
There must be many possible applications for microtechnology in the fields of physical and sensory disabilities — remember, these include handicaps such as deafness, blindness, diabetes and epilepsy, as well as the more obvious physical impediments .

1st Prize
DAI PERSONAL COMPUTER

2nd Prize **£100** 3rd Prize **£50**

Articles of around 2500 words are invited, which can be either theoretical or a description of an actual application (with photographs, if possible), and which we will print in *PCW* later in the year. Entries will be judged by *PCW*'s Editor, David Tebbutt, Adrian V Stokes, Chairman of the IYDP Technology Working Group and Judith Hann, presenter of Tomorrow's World and science writer.

Please send your entry to IYDP Competition, 14 Rathbone Place, London W1P 1DE, enclosing a suitable SAE if you would like it returned.

Personal Computer World

19 81
International Year of Disabled People

Data Applications Ltd has kindly donated the first prize of a 48K personal computer worth £595. Plugging into the domestic TV, it provides sound, colour and high-resolution graphics.
Sharp Electronics (UK) Ltd has kindly donated the third prize of £50.

The IYDP has requested an extension of the deadline for the competition to 31 July 1981. This is to help students fit their efforts around the academic curriculum.

YANKEE DOODLES

Tom Williams reports on the American side of the microscene

Adam Osborne, well-known publisher and lecturer on the personal computer scene, has begun manufacturing his own line of microcomputers. The Osborne 1 computer system, which was announced at the West Coast Computer Faire, is revolutionary in that it incorporates nothing revolutionary — except size and price. Osborne has based his product on the premise that, 'We do not need the abundance of more powerful, more expensive microcomputers which the industry has been producing. We need a microcomputer with the capabilities of existing products but with a much lower price tag. We need a portable microcomputer capable of performing a large number of straightforward tasks, using industry standard operating systems and programming languages.'

As a result, he has introduced the Osborne 1, which is immediately impressive by virtue of its compactness and portability. It was purposely designed to be able to fit under the seat of a 'plane and yet it incorporates features that have come to be standard only in systems of much larger size and price. The basic unit includes a Z80 CPU, 64 kbytes of RAM, two minifloppy disk drives, CRT and keyboard with numeric pad and a host of system and application software for $1795.

The CRT measures 5in diagonally and provides 24 rows of 52 characters. The display, however, is a window on a screen of 34 rows of 128 characters including upper and lower case, two screen intensities and underlining, with limited graphics capabilities. The display is implemented in 4k x 9 bit RAM.

The keyboard is a standard typewriter style with a 10-key numeric pad and snaps together with the computer to form a weatherproof carrying case. There is even room enough in the face of the unit for pockets in which up to 20 disks can be stored.

Of the 64 kbytes of RAM, 4k are used by the display, leaving about 60k available to the user. System software in ROM is held in a separate address space. Two standard interface ports are provided with the Osborne 1, an IEEE 488 interface useful for instrumentation and control and a standard RS232 port, useful for attaching a printer.

The two 5¼in disk drives hold about 100k each, but double density, double-sided drives will soon be offered as an option. Alternatives to the relatively small display will also be offered in the near future. These include a 9in monitor which reproduces the 5in display, and a 12in monitor which will show a standard 80 column, 24 row display.

But as if all this hardware were not enough, the Osborne 1 also comes with a whole pile of ready-to-run software. At the system level, it provides CP/M, CBasic and Microsoft Basic, probably the most popular general-purpose software packages available for personal computers. But there's still more.

The base price of the system even includes two applications packages: the Wordstar word processing package by Micropro, with the MailMerge option, and what Osborne calls a 'CP/M-compatible electronic worksheet'. By this we can presume he means a system similar to, but not identical with, the VisiCalc program that has proven to be such a boon to the personal computer industry.

And I haven't finished yet: there are even options in addition to the double-density disk and CRT variants mentioned above. The user can also obtain modem electronics with an acoustic coupler and a battery pack which can provide from three to five hours of operation away from an electrical outlet.

In introducing the Osborne 1, Adam is really doing nothing more or less than practising what he has been preaching for a number of years: that microcomputers should be general-purpose, price effective, compatible tools that are accessible to a broad range of users who are not computer people but who have a vast variety of problems to solve and jobs to do. The emphasis is not on fancy bells and whistles but on the 'vanilla flavoured' practical machine that so many people need and at a price that is going to be the talk of the industry for some time to come.

This observation naturally raises the question, 'What good, then, are the new 16-bit and now (God help us) 32-bit systems that will fit on a desktop and directly execute high-level languages?' The answer, obviously, is that they are good for a lot of things such as real time simulations with colour graphics and voice I/O. . . and these are things that will soon be within the reach of the interested individual.

But the point of the Osborne 1 is that you don't go rabbit hunting with a buffalo gun. Neither do you venture into exotic places where you can't get standard calibre ammunition — or the Jabberwock might eat you. The average user does not need the fastest, flashiest and the sexiest; he needs reliability. Adam Osborne has renewed a focus on that need and I, for one, wish him well.

So do we — Eds.

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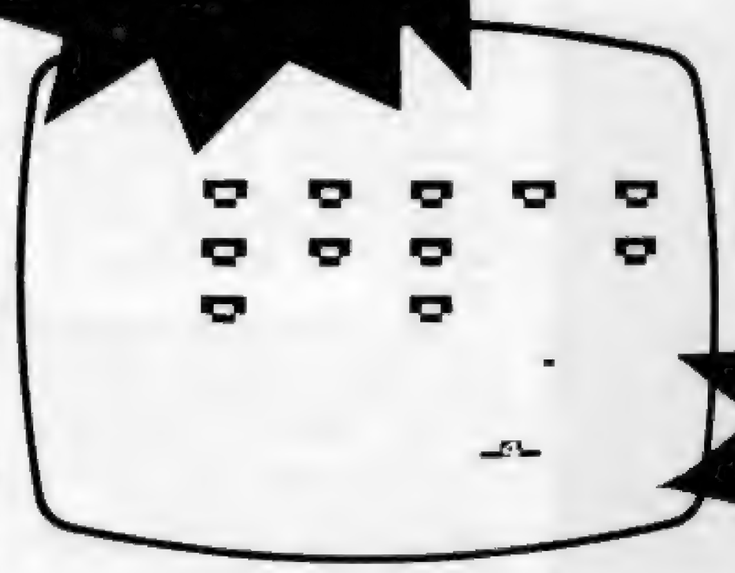

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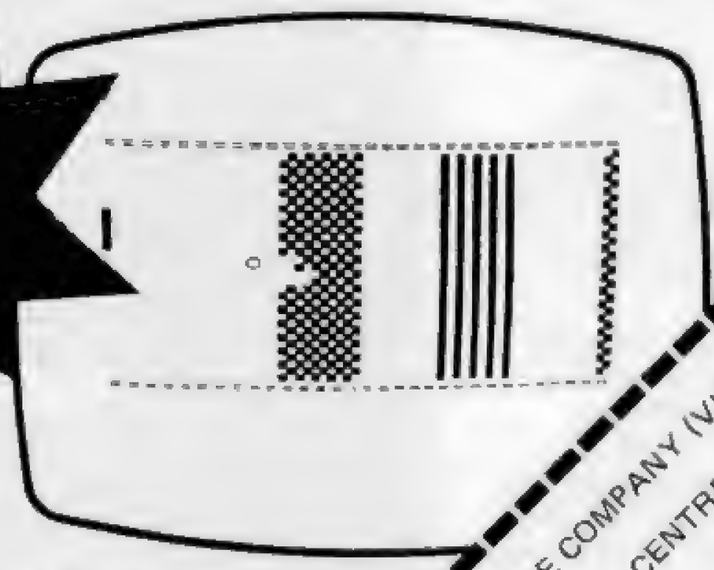

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NEWS

ComputerTown UK! is a nationwide network of voluntary computer literacy centres. All letters should be addressed to CTUK! c/o 14 Rathbone Place, London W1P 1DE

It's good news again this month with Retford and Ealing getting off the ground. Retford is in Nottinghamshire, several miles away from the existing ComputerTown at Sutton in Ashfield, and has been started by Bill Gibbings. Bill bought his first copy of *PCW* just a couple of months ago and the idea of ComputerTown rather caught his imagination; he promptly set about finding appropriate premises for his own ComputerTown. He tried the library, thinking that they might be prepared to buy an Atom or something for permanent installation, but this foundered on the usual library budget problems. He then thought it would be a good idea to have a sort of open evening with all sorts of machines and applications software being demonstrated, so he hired a church hall and began ringing round all the people he could think of who had micros and who might be prepared to bring them along. He managed to get eight people and nine machines in time for the big night. The machine line-up was: two Z80s, a PET with disks and a printer, an Apple, a TRS-80, a Sharp, a North Star, a Nascom and an Open University machine which was unattended — unfortunately the owner couldn't come along and no-one else was able to use the machine.

A variety of people were demonstrating their systems: a doctor, an engineer and a businessman were demonstrating their own business applications while an education expert was showing how he handled a village census on his micro. Thanks go to 'John' who came all the way from a computer club in Doncaster — a distance of 20 miles — just to lend a hand. Games were in evidence, too, and while the whole event had been planned as a series of demonstrations, by the middle of the evening it was clear that the 60 or 70 visitors wanted to get their hands dirty. The evening was a roaring success and everyone who participated had a great time. Bill, I suspect, was feeling a little under the weather the next day but after all the planning and worrying that is only to be expected.

This particular event marks an interesting departure from the way we have been running other ComputerTowns. Bill had real people there with real applications and they were able to discuss what life with a micro is really like. There were no commercial interests there to mess things up. Even the most honest person in the business of selling micros will think that his particular machine is better than any other whereas the actual user, while still lacking any sort of perspective, can be entirely honest about his own machine, software and personal experience with them.

Bill says that his 'event' approach is best for him because of the various pressures on his volunteers. He plans to hold his next session at Eastertime, during the school holidays. I must say that I rather like his approach — it is an extremely practical way of getting people interested in microcomputing. Before I move on to other ComputerTown News I must just say that the first we knew of Bill and his activities was when a poster announcing his event dropped through the *PCW* letterbox a few days before the big night itself! Anyone wanting to contact Bill (with offers of help, maybe?) should telephone Retford 706923. Thanks Bill, you're doing a grand job.

Mike Baker wrote from Hanwell to tell us about his progress with the Ealing ComputerTown. He has started sessions at Acton Library on Tuesday afternoons and would very much appreciate some volunteers to help him out. So far he's been unable to find anyone else free at that time. All offers to Mike please at 5 Edinburgh Road, Hanwell, London W7 3JY.

Vernon Gifford rang with news of ComputerTown Croydon. It has run a couple of sessions so far and Vernon is very encouraged by the results. He is extremely grateful to two companies, Encotel and Wego, for their loans of equipment to his project. Croydon ComputerTown is sponsored by the Croydon Computer Club in collaboration with the local library and sessions are run every Monday in the children's library, Katherine Street, between 4pm and 7pm. Like everyone else running ComputerTowns, Vernon could really do with some help on these sessions. If you'd like to help, Vernon lives at 111 Selhurst Road, London SE25. Soon a Saturday session will be opening as well and for this Vernon will be looking for the loan of more machines. Any offers?

Now a few words about something which could become a problem for all of us running ComputerTowns. I have started to get phone calls from people in business who feel that by associating themselves with ComputerTown they can somehow enhance their credibility and, presumably, increase their sales. We must be extremely careful when confronted with this situation that we do not lend our name to any commercial activity. I do not exaggerate when I say that this will kill ComputerTown. It will be seen as a marketing organisation, which it clearly is not. If you're in any doubt about ComputerTown's position on this then I suggest you read the ComputerTown launch article in the November 1980 *PCW*. We welcome help from people in the industry — indeed it is unlikely that ComputerTown could have got off the ground without help from people like Leasalink, Supersoft and Encotel to name but three. And it is even possible that these companies will receive some business as a result of their involvement, but the fact is that companies such as these offered their services to ComputerTown freely. I'm sure that they would all welcome some spin-off business as a result but none of them are abusing this special relationship by treating ComputerTown as a sales pitch. If you are in any doubt about lending ComputerTown's name to an activity, we'd always be happy to discuss this problem with you. Leave your phone number and a brief note of the problem with *PCW* and we'll ring you when we get home.

John Bone wrote from ComputerTown North East to say that things are going well for the project in Newcastle. They chose the name CTNE! because more than one ComputerTown is involved and the team 'want to help the whole of Tyneside'. At the moment they're apparently renting rooms from a local political party at £4 per day, although by the time you read this they may have shifted their centre of operations to a community centre.

Can we set up a register of software which we are prepared to swap around within ComputerTown? Obviously we are only interested in public domain stuff unless it is with the express and written permission of the author and distributor. Perhaps you might give some thought as to how the stuff can be copied and distributed as cheaply as possible for everyone involved and send your suggestions to us as well.

Alan Northcott writes from Winnersh to offer his services to ComputerTown. Anyone in the Reading area who feels like joining in should contact Alan at Rushmoor, 464 Reading Road, Winnersh, Wokingham, Berkshire RG11 5ET. We look forward to great things from this area — it is, after all, Britain's answer to Silicon Valley!

It is only a couple of weeks since I wrote the last ComputerTown piece so we have had relatively few letters. Other than the above we have received interest from Sheffield, Aberdeen, Aylesbury and Worcester. If you feel you'd like to help, then send a letter to CTUK!, 14 Rathbone Place, London W1P 1DE and we'll pass your details on. If you want to write to us and you need a reply then please enclose an SAE. Please don't try to telephone the *PCW* offices since we do ComputerTown work in our own time.

Thanks to all of you who are helping to make ComputerTown a success. It is attracting the attentions of all sorts of interesting people: the BBC, the NCC and a couple of MPs, just to 'name drop' three of them. I'm sure that later on this year some very interesting projects will be announced which will help to spread the ComputerTown word even further.

Keep writing in with all news of your progress and particularly with advice which you can offer other ComputerTown organisers as a result of your own experience with the project. We look forward to hearing from you.

COMMUNICATIONS

PCW welcomes correspondence from its readers but we must warn that it tends to be one way! Please be as brief as possible and add "not for publication" if your letter is to be kept private. Please note that we are unable to give advice about the purchase of computers or other hardware/software — these questions must be addressed to Sheridan Williams (see 'Computer Answers' page). Address letters to: 'Communications', Personal Computer World, 14 Rathbone Place, London W1P 1DE.

Pricey Pascal

As a newcomer to the world of personal computers. I'm astonished that it seems to be lagging so far behind mainstream computing. Full marks to Malcolm Peltu for his anti-Basic campaign.

These pathetic, slow, interpretive Basic systems are fine for beginners, but surely the road to good programs must be to wean the serious programmers and get them onto some high level language that will support files, procedures parameters and recursion.

As far as I can see the main obstacle to widespread use of Pascal is the high cost of compilers, so come on soft software writers, how about a 'Pascal Starters Kit' for under £30?

Keep the Pascal and assembly language programs coming!

What is the most efficient keyboard layout, if qwerty was designed to slow typists?
R L Barbour, South Queensferry, West Lothian

It rather depends on how you define 'efficient'. For ease of learning and medium typing speeds, the Microwriter chord keyboard (December 1980 PCW) *is very good. Various attempts have been made to replace qwerty with an arrangement which shares the work more evenly between left and right hands (qwerty keeps the left hand far busier) — one such (British) keyboard is the Maltron. Qwerty is, however, so firmly established and there are so many qwerty-trained typists, that replacing it is going to be a very uphill struggle — Ed.*

Wrong Tiger

Thank you for publishing our press release on our Model 560 Paper Tiger (*PCW* February 1981). However the picture you show is that of the 460

The 560 is not aimed at the typewriter market. It gives good quality printing with proportional spacing, right hand margin justification, high speed (150 cps) printing, enhanced printing, full graphics and many other features. If you know a daisy-wheel with all these features for under £1000 end user, I would be delighted to hear of it and to add it to my product range.
Richard Kent, Director, Teleprinter Equipment Ltd

What a bind

Ring binders suitable for American documentation *are* available from commercial stationers in this country. I use 'Twinlock Ref V3S 1in capacity 11 x 8½ standard PVC variform ring'. I hope this helps Don Finlay as well as your readers.
Steve Withers, Coventry

Easy loader

With reference to Hasse Taub's letter in the February issue, I had similar problems but found that SAVEing and LOADing the ZX80 was trouble-free if the plug not in use (ie 'Earphone' socket during SAVE and 'Mic' during LOAD) was removed at the recorder.

Incidentally, the tape I use is sold in the local market at three C60 cassettes for 45 pence!
O L Harding, Lincoln

Program plea

I have been a regular reader of your magazine for over a year and look forward each month to its publication. I always type in the program listings and greatly enjoy the games. However they are tending to get repetitive and far from addictive. I feel that there is a need for some program listings which perform a purpose rather than provide for innumerable varieties of chase across the VDU screen. I, for one, am desperate that my computer should start to perform some of the tasks at which it is good and not just be used as a games machine.
Brian Richardson, Benfleet, Essex

We see what you mean but don't entirely agree with you. We do print a number of useful programs both in the body of the magazine and in the Programs section. However, we take note of what you say so we hereby request that people with programs of a serious nature submit them for publication. If you think your program deserves more than an introductory paragraph and a listing in Programs then send us a copy (on cassette) together with an outline of an article which you propose should accompany it — Ed.

ZX80 memory

I read Mr Kirkland's letter about finding how much memory is free on the ZX80 and thought that you might like to see my solution to this problem.

The number of free bytes is returned by the function USR(2383), which gives a negative result. The result is the number of free bytes between the end of the display file and the top of stack and so no estimation of the size of the display file or stack is required.
J D Slodzik, Maldon, Essex

Super Superboard

Ever since I took up the computer hobby, I was always interested in producing 3D effects on my Superboard. In this program, although I have not used a utility for high screen resolution, the effects are pretty satisfactory. The secret is the revolution of some form of sine-wave about the 'Y' axis. The steps of revolution depends on the value of 'A' depending on the steps of countdown. So if the steps of 'A' to be counted is small, then this would result in closer steps of revolution.

As you see from the listing there is not a great deal involved but the run time for this program would be a great deal!!

The program is self-explanatory and it can be used on any machine and it is a lot of fun! Line 80 can be changed to produce any odd shapes and line 60, the steps decide on the number of cycles, so the greater the steps, the more cycles you would get.
A Sarafian, London

```
 10 FOR X=53248 to 55295: POKE X, 32: NEXT X : REM CLEAR SCREEN
 20 FOR A=0 TO 2.5 STEP .2: GOSUB 50: NEXT A
 50 G=53248: REM STARTING POINT
 60 FOR X=0 TO 180 STEP 6.2: REM** SUITABLE FOR MAX ACCURACY**
 70 LET Y=(X*3.141592)/180
 80 C=1 . 3*SIN(Y)-A*SIN(Y):REM** C=DIFFERENCE OF TWO SINE WAVES**
 90 P=INT(15*ABS(C)+ .5)*SGN(C)
100 IF C<0 THEN W=187
110 IF C>0 THEN W=161
120 POKE (G+P+24),W
130 G=G+64:REM*** THE VALUE FOR WHICH G IS ADDED TO DEPENDS ON
                                                  THE SCREEN FORMAT***
140 NEXT X: RETURN
```

See 'Super Superboard'

Where are they?

In your March issue in 'Yankee Doodles' you mentioned a company called Giltronix from Palo Alto who specialised in RS232 automatic and manual switching equipment at very reasonable prices.

I need this facility for sending my Microwriter-keyed information down the line to a bureau for processing. Could you send me Giltronix's address, or is there anyone in the UK who could supply my simple needs.
F Clifford, Blackheath

The address is: 450 San Antonio Angelo, Palo Alto, CA 94306 and the phone number is 010 (415) 493 1300 — Ed.

Hooked but not hired

About ten months ago I was introduced to computing by a friend with access to an 8k PET. Inevitably I became completely hooked on computers and their application, even to the extent of spending all my spare cash on magazines and books on the subject.

Computing, and programming in particular, became my 'fix' to such an extent that I gave up my established vocation (after ten years as a research microbiologist), determined to become a full-time programmer. The thought of being paid to do what I considered to be an all-time favourite hobby seemed too good to be true. I therefore applied, and gained entry to, a TOPS course in commercial computer programming designed to turn students into Cobol programmers.

I completed the course and now, three months later,

I am still unemployed despite sending out over 150 applications for jobs. I have yet to obtain a single interview!

What can be done to dispel this Catch-22 situation in which people with less than 12 months' experience cannot get a job? Just how do you get that first 12 months' experience when nobody is willing to take on a trainee with all its associated risks?

I *am* going to become a programmer one day, even if I have to start as a teaboy or a lavatory attendant in order to get on the ladder. If anyone out there wants to employ a computer 'junkie' with limited Basic and Cobol experience tempered with lots of enthusiasm then I'd really like to hear from them.
Rod Mansell, 43 Ladybank, Birch Hill Road, Bracknell, Berks RG12 4HA

Mr Mansell's problem is shared by many others and PCW is going to try to do something about it. We know that investment in trainees is expensive and doesn't always pay off but if the industry is to expand then it is absolutely vital for fresh people to join it. We therefore are going to make an offer — any company prepared to employ a trainee programmer should write to us giving name, address, nature of business and type of vacancy. We, in turn, will publish a list of replies received in the August PCW. *If, by any chance, we are so overwhelmed with replies that we can't publish them all in one issue then we'll spread them over a few issues. Please write to us by 30 May to be included — Ed.*

Repair job

Since I regard your publication as the house magazine of Commodore *(we don't — Ed)*, maybe you would be interested in the following true story.

The head release lever on my lever on my Tandy Lineprinter II recently suffered a fracture in the shaft and I phoned the Manchester Tandy Computer Centre to enquire about a replacement. They got in touch with their repair department nearby and rang me back with the information that it would cost £2-3 for the part and about £15 for service charges.

I wrote to Centronics in Burgess Hill, Sussex and later they phoned me back to confirm which part I needed, since they call the component a cam head gap adjuster. They decided the cost would be 28p plus postage and packing. On receipt of my cheque they dispatched the part within a week and it took me exactly two seconds to fit.
Dr Norman A Law, Manchester

HP source too costly

It is heartening to read that MPs are at last getting computerised ('Commons Report' by Ian Lloyd, *PCW* March 1981) and have their own online information storage and retrieval system.

I have grave doubts, however, if there will be many takers outside the House of Commons, as prices currently quoted by Scicon for online service to non-parliamentarians include a £1990 annual subscription charge, plus £55 per hour connected. At present this covers Parliamentary Questions only, although there are plans to extend the database.

Compared to established American systems such as Lockheed's Dialog or SDC, for which there is no advance payment and you pay only for connect time, the English system represents very poor value for money and is grossly overpriced. Using the systems quoted and without advance payment, it is possible to have access to some 100 million references, bringing these systems within the range of even the smallest user.

So unless you are an MP and can have your service paid for by the taxpayer, I suggest the rest of us stay away from POLIS until: a) the database is greatly enlarged and b) the price is drastically reduced.
Peter Douglas, London SW1

NewBrain? Not yet

I would appreciate it if you could let me know if *PCW* will be running a Benchtest on the Newbury NewBrain in the near future. If so can you say in which issue?
H J Stovold, Exeter, Devon

When NewBrain goes into production later this year we fully expect to bring you a Benchtest. We're sorry but we are not in a position to give any further details.

Black mail?

Have you ever wondered who gives your name to these people who send offers and such through the post to you? Well, there is a way of working out the answers.

Many of these people now employ mailing lists, printing the address out onto sticky labels. This method has two useful consequences. One is that one particular mailing list will repeat the name exactly each time it is run, it may add extra information sometimes such as rank in company. Since there are many different ways of phrasing a name, plus the ease of errors, this means that different lists will have slightly different entries for the same publication. For example, I have been addressed as: R Poynter, R A Poynter, Ray Poynter, Roy Poynter and a whole host of more obscure variations. Then we have the address which again throws up inconsistencies.

All of this gives us our chance to 'watch the watchers'. What I do is to keep copies of the labels on my mail, making a note of whom the mailing was from. Then from time to time I find a match, sometimes the bedfellows prove to be quite interesting. However this method is not proof, so in self-defence I think it's better that I do not publish my suspicions. But as a pastime it is very rewarding.
Ray Poynter/r Poynter/Mr Poynter, Nottingham

Cowboy sort out

I own a ZX80 computer and, not being able to master the art of programming myself, I began collecting and buying some of the bewildering amount coming onto the market. I didn't realise until recently that program quality differs so widely between suppliers. Is there any way that your magazine could help other readers like myself from wasting their money on rubbish and being taken for a ride by software cowboys?
John Joseph Oxley, Bessacarr, South Yorkshire

We'd like to help but, short of reviewing every software product on the market, we suggest that the best approach is to invite readers to write to us with their experiences. If sufficient evidence builds up for or against a supplier then we'll start investigating and publishing our findings. Write the name of the supplier on the back of your envelope and send it to Investigation Department, PCW, *14 Rathbone Place, London W1P 1DE — Ed.*

Cuck op

Here is a misprint from last Saturday's *Guardian* which might amuse you. . .
Frank Little, Swansea

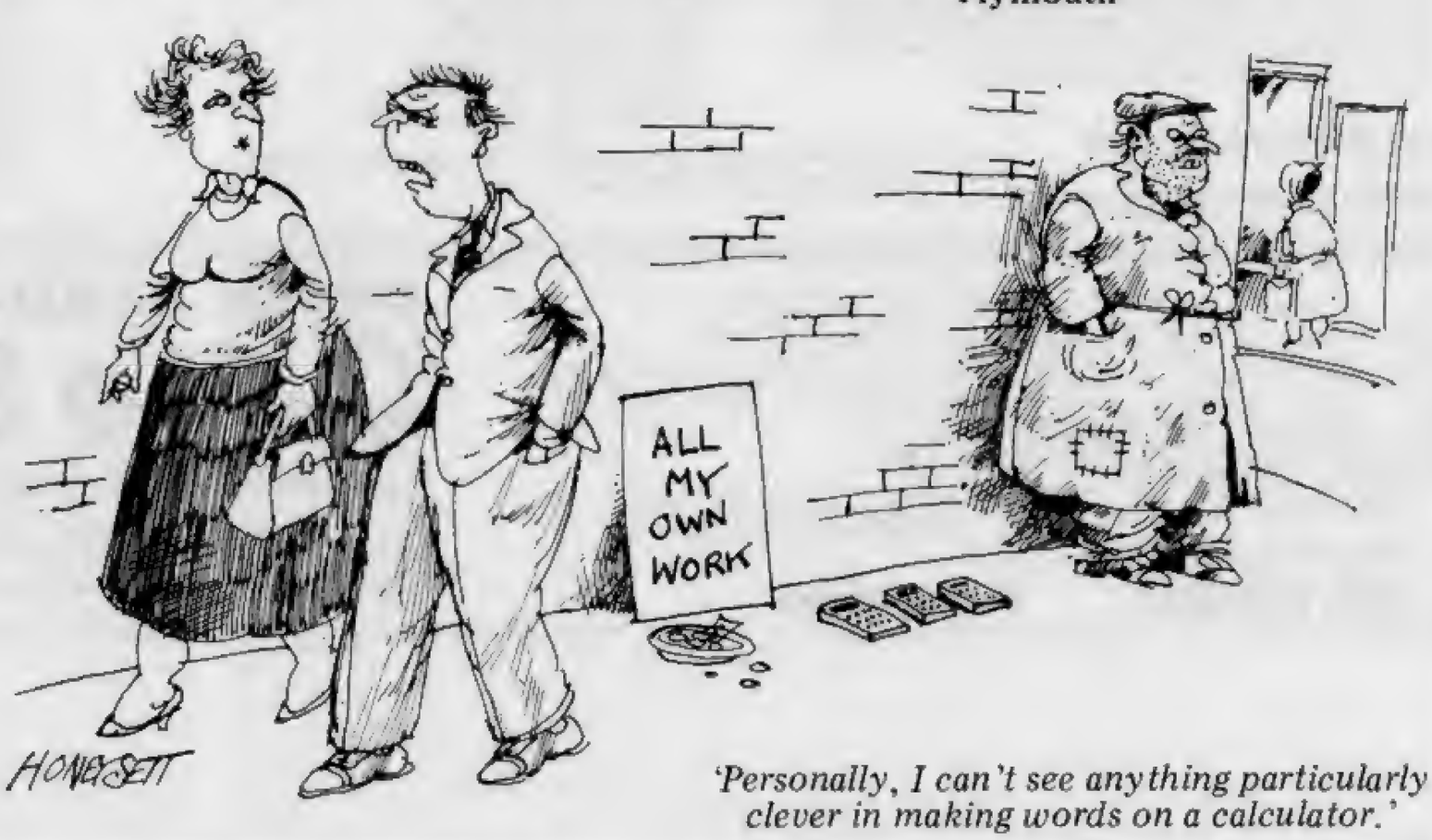
10 40 ARENA: The Smallest Theatre . . . It's the two-man company run for 17 years by Barrie and Marianne Hesketh, online begetters, and players of every production — including a two-handed Tempest — in their converted Scottish cowshed.

What's wrong with that? I often go online begetting — Ed.

Dr Micro

I would be very pleased to hear from anyone who has information or ideas about using microcomputers in general hospital wards for teaching or for management.

I own a Sinclair ZX80 with a 16k RAM pack and would like to be able to put it to use in an on-ward teaching situation.
Valerie Garland, 12 Park Hill Crescent, North Hill, Plymouth



'Personally, I can't see anything particularly clever in making words on a calculator.'

BENCH TEST

Another new Japanese micro, reviewed by Steve Withers

The Pasca 640 is a large machine, being a single integrated unit including two 8in disk drives. It measures 26in wide by 28in deep and is 18in high; thus, while it fits comfortably on a desk, there is little room for much else, except for working documents. It is sufficiently heavy to require two people to carry it safely. In view of the current trend for Japanese companies to produce miniature hi-fi systems and pocket computers, I found the Pasca's bulk surprising.

Hardware

A 12in monitor display 24 rows of 80 characters in green on black. A plastic cover is fitted, giving excellent contrast and preventing reflections, even under adverse lighting conditions. The contrast control is mounted immediately below the screen, next to the on/off switch, so there is no need to fumble around the back of the machine.

In addition to the usual upper and lower case character set (with descenders), there are a number of special characters including some maths symbols, a '£' sign (replacing the 'hash' character) and various graphics. Cyrillic and Arabic character sets are available as options but as the character generator is a 2716 EPROM, custom character sets may be installed by programming a replacement, following the instructions in the manual (the Pasca has no provision for EPROM programming itself, however).

The appearance of the cursor may be varied — either a solid block (steady, slow or fast flashing), or a flashing underline may be used, or the user can select an invisible cursor. Whichever is chosen, the cursor may be addressed to any screen location by using a subroutine provided by the system software. A second routine returns the cursor's current position.

The display itself is not completely steady, having a tendency to wiggle slightly. This is particularly noticeable when reverse video is used but it is not so bad as to be irritating in normal use. In common with most machines with integral disk drives, the display jerks disconcertingly during disk accesses.

The keyboard has a pleasant snap action giving a very positive feel, backed by a 'peep' accompanying each depression. I found this extremely irritating but it can only be disabled by removing a link on the circuit board. Since you will either like or loathe this feature, the absence of a switch is unlikely to be noticed. A reset key is positioned on the keyboard well away from the other keys, so accidental resets should be uncommon.

The arrangement of the keyboard is slightly unusual, with the control key in the top left-hand corner instead of its more common position at the bottom left. A CANcel key is provided next to 'Q' and TAB is to the left of the space bar. I would have been much happier with a CAPS LOCK in place of SHIFT LOCK, especially as the system responds differently to shifted and unshifted control characters. In fairness, a row of 13 function keys and a set of cursor keys provide one-key alternatives to the common control functions but this restricts the transfer of skills to and from other machines. In production models these function keys will be inscribed with their CP/M and WordStar functions. My final complain in this area is the arrangement of the cursor control keys. Considering the amount of space available on the keyboard, a cursor cluster arranged like the points of the compass would be practical and much nicer to use.

According to the manual, pressing a key causes a processor interrupt to ensure that the keystroke is recorded. This may be so but as the keyboard buffer contains only one character, there is still a chance of losing characters during periods of intensive processing.

The unremarkable electronics are mounted in two 13in x 11in circuit boards which slide out from the rear of the machine after a small panel has been unsnapped. Access to the monitor, disks, etc, is very easy, as the whole top section of the cabinet lifts off after removing two small screws on the back panel. Two fans are used to keep things cool but they do contribute to a noise level which is higher than I consider comfortable.

The processor used is the Z80, made in Japan by Sharp, with LSI support chips controlling the video display and disk drives; 64k of 4116-equivalent dynamic memory is fitted as standard, with 2k used as the screen refresh RAM. This is the only intrusion into memory space, as the bootstrap ROM is disabled once CP/M is loaded.

IBM 3740 format is used for the two 8in drives giving 243k user capacity per disk. This format is the 'standard' for CP/M and so makes program and data transfer to and from different machines a possibility, although the plethora of other formatting standards (and the popularity of 5¼in disks) prevents it being a certainty. The disk drives themselves are manufactured by another Japanese company, Toshiba. To reduce disk wear, the heads unload almost immediately after reading or writing a sector but this has the disadvantage of generating a noise like a demented fruit machine when several operations are carried out in quick succession. This was particularly noticeable when running the disk test programs and when listing the directory, but Westrex has solved the problem by slightly modifying the drives.

One serial RS232 port and one Centronics compatible parallel interface are provided to allow connection of printers or other external devices. Unfortunately, the serial port baud rate is set by a jumper on one of the main circuit boards, so it would seem wise not to plan to use the port for both a 300 baud modem (assuming BT approval) and a 9600 baud printer. Westrex supplies a selection of printers as optional equipment for the Pasca, including the Epson MX-80 provided with the test machine. Provision has been made for two additional connectors on the back panel and a second RS232 interface may be available in the future.

A bottle-green dust cover bearing the Pasca logo is supplied at no extra charge.

Software

In common with most disk-based Z80 systems, CP/M is supplied as the standard operating system. In addition to the usual utilities, some machine specific programs are provided: DEFLP allows the user to specify the serial or parallel port as the list output device; MEDIA is used to format a new disk, or to copy whole disks (with or without the system tracks); MX80 sends a hex string in character form to the printer (eg MX80 OC<cr> causes a form-feed); CURSOR changes the appearance of the cursor. The public domain Basic-E pseudo compiler with three games programs completes the package.

Since Westrex is a hardware-oriented company, it has delegated responsibility for software to Phipps Associates, a small consultancy firm. Phipps has already produced MONITOR, a set of machine code routines to provide Microsoft Basic-80 with the type of forms oriented input/output routines advocated in 'Face to Face' (*PCW* October 1980). To make life even easier for the programmer, the disk includes a collection of Basic functions and subroutines which may be merged into application programs as required. Thus there is no need to access the machine code directly.

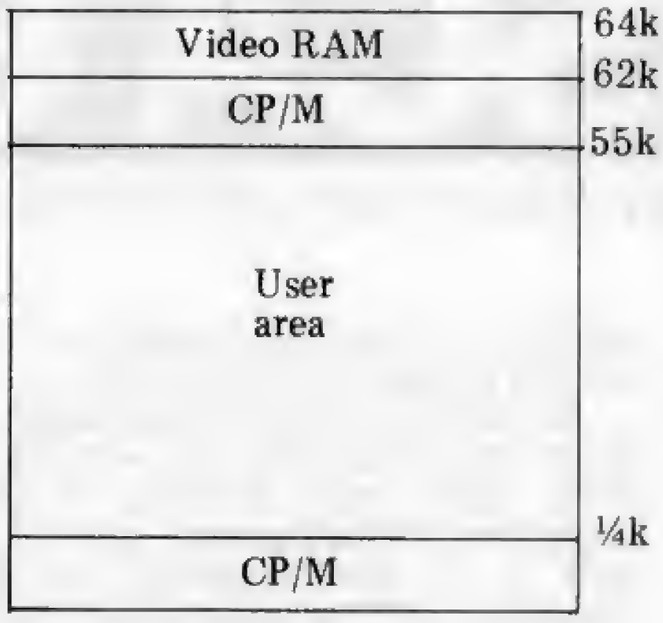
The construction of the blank form is achieved through a separate program called FRAMES. Once the designer is happy with the form, the program analyses the contents of the screen to extract the prompts and measure the size of the data fields.

Four constraints may be applied to each field: type, data type, minimum length and number of decimal places. A field's type determines whether it is to be used for input or display, and specifies if input is optional or mandatory. The data types are Date (eg 23.11.81), Real (eg 345.99), Integer (numbers only), Alpha (A-Z, 0-9, and space), String (any character), and Boolean (Y or N). When the form is used by a program, these restrictions are imposed before the input is transmitted to the program, thus greatly reducing the need for explicit checking. The user of such a program also benefits, as he or she can edit the contents of completed forms before 'transmitting' them.

Some well-known programs are described as 'Approved Software' — that is to say, any required customisation or support will be provided by Phipps. The current list is Basic-80 (compiler and interpreter), Macro-80, MAGSAM, SUPERSORT and Wordstar/Mailmerge plus the MONITOR program described above. The copy of Wordstar provided made good use of the Pasca's memory-mapped display to update the screen rapidly. The ability to produce reverse scrolling is particularly useful. However, the 'printer busy' test had not been added and without such a test the performance of the 'print while editing' feature suffers to the extent of becoming virtually unusable.

Many of the other programs written for use on CP/M systems should operate without modification, and the 'Approved' list is expected to grow as more programs are evaluated.

Memory map



Potential

The machine's specification and the list of approved software suggests that the Pasca is intended for the business market. My feeling is that the styling of the machine will result in its use for clerical purposes, rather than as an aid for the sophisticated manager. Whatever cachet Sir Freddie Laker gains from the Apple sitting on his desk is unlikely to accrue to the user of a Pasca.

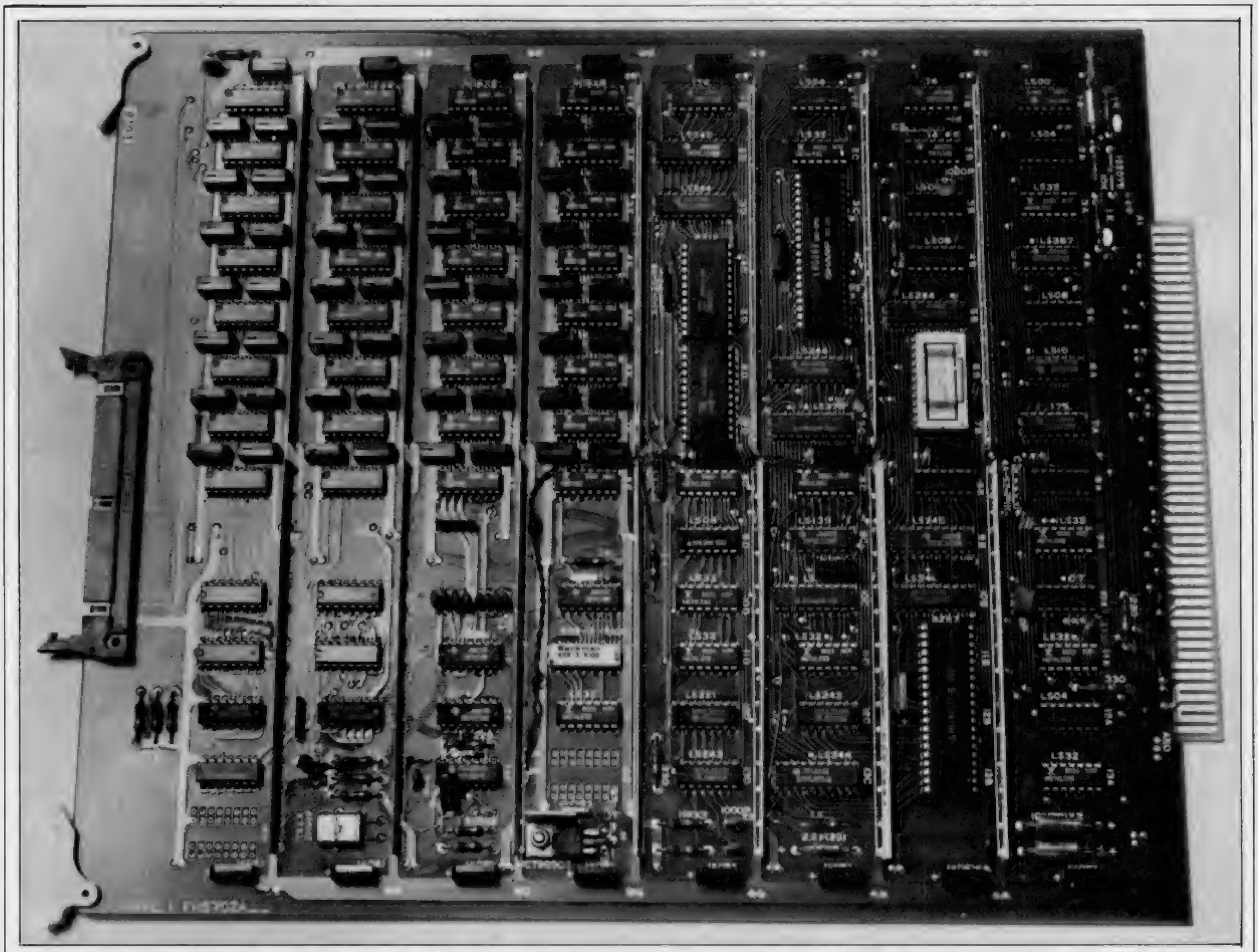
Benchmark timings

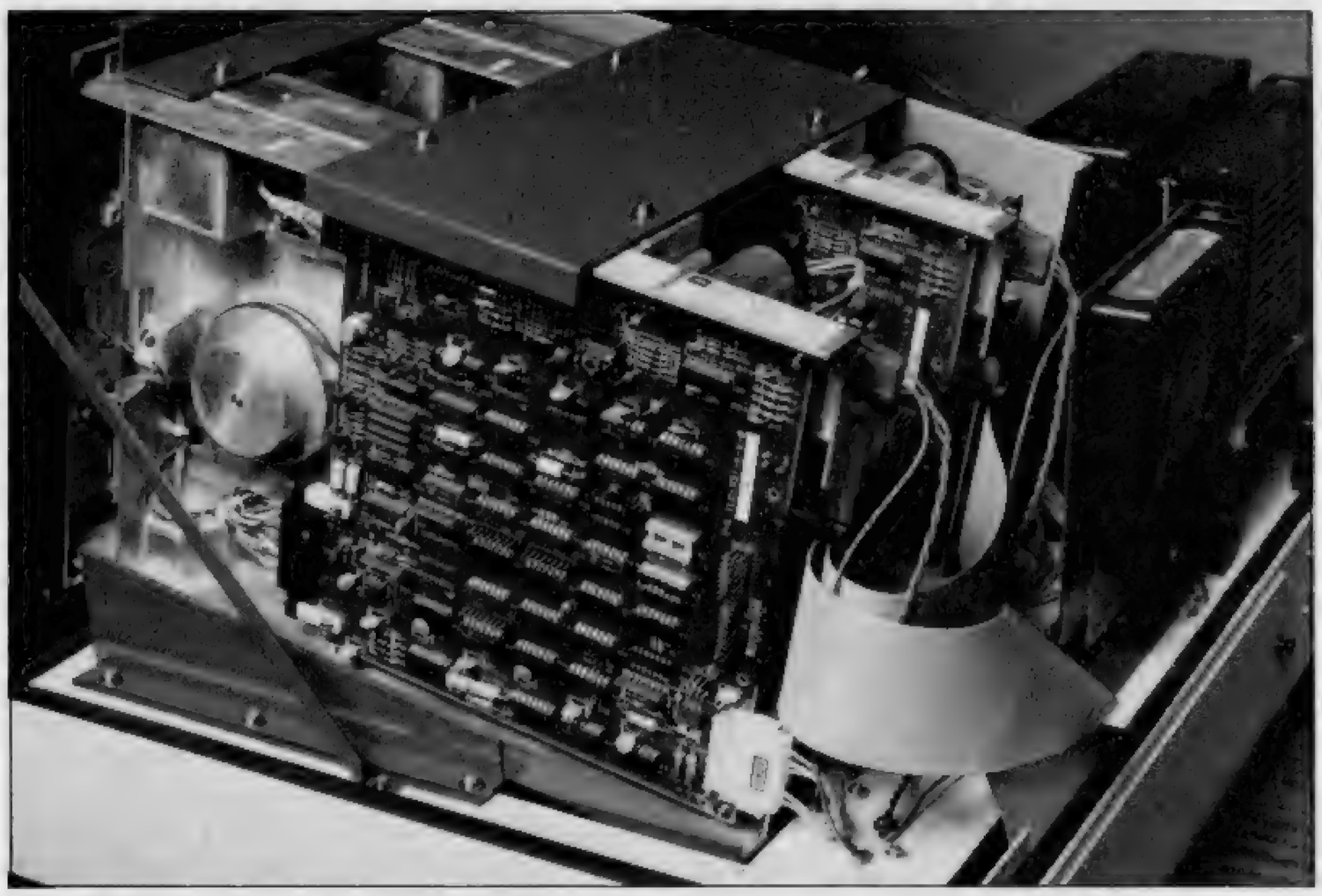
These timings (in seconds) are for Microsoft Basic-80 programs, as the Basic-E manual was not provided with the test system.

DT1	1	BM1	2
DT2	22	BM2	7
DT3	22	BM3	19
DT4	19	BM4	18
DT5	21	BM5	20
		BM6	36
		BM7	57
		BM8	10

Technical Data

CPU:	Z80, 2 MHz.
Memory:	64k dynamic RAM, 2k EPROM (2716).
Keyboard:	89 key; Separate number pad, cursor keys and control keys.
Screen:	12in diagonal.
Disk drives:	Twin single-sided, single-density 8in drives.
Bus:	Non-standard.
Ports:	1 RS232, 1 Centronics compatible parallel.
System software:	CP/M 2.2
Languages:	E-Basic (others available at additional cost).





Documentation

Leaving aside the manuals supplied with the proprietary software, the Pasca's documentation is of varying quality. The 'OEM Manual' which deals with the hardware contains (for example) a number of diagrams which are poorly printed and captioned in Japanese — but that's better than nothing at all. If the manual is meant for the user (despite its name), the whole layout is wrong but on the other hand its level of detail is sufficient for only the most experienced service personnel or systems programmers.

A 20-page booklet written by Phipps Associates explains the essential matter of switching on and goes on to describe the use of the machine-specific utility programs. Finally, there is a summary (taken from the OEM Manual) of the hardware features which impinge on the programmer or operator. The author of this manual has managed to write concisely without sacrificing clarity. I suspect he or she also wrote the MONITOR manual, since this explains the philosophy and use of the programs in a very similar style. By following the fully-worked example, programmers should soon find themselves able to utilise the power of this aid.

Prices

Retail prices had not been fixed at the time of writing, but are expected to be around £3500 for single units without a printer. OEM/distributor prices range from £2890 each (1—4), to £2635 in quantities of 50 or more, which suggests there may be room for discounting by adventurous dealers.

Conclusions

The Pasca 640 joins the mass of Z80 — CP/M systems already on the market, at a price which is considerably higher than some computers offering comparable facilities but in line with at least one other similar machine. It is almost as if some manufacturers are attempting to use higher prices to avoid the 'toy' label applied by the so-called professionals who have yet to realise the power of microcomputers.

Westrex's plans for the future are equally conventional: a 4 MHz Z80A version, a second RS232 port and a 10Mb hard disk. Since the MONITOR routines could be modified for other computers with memory-mapped displays (they were originally produced for the Panasonic), the Pasca's attraction must be its integral twin 8in disks. If this is an essential feature, all well and good, but unless the Pasca is found to be exceptionally reliable, a more cost-effective solution can probably be found elsewhere.

MAGIC WAND

In the first of our new series of word processor Benchtests, Peter Rodwell jumps in at the deep end with a CP/M-based system.

Magic Wand is a very comprehensive word processing package produced by Small Business Applications Inc of Houston, Texas. It runs under CP/M and is one of the most versatile micro-based word processor systems currently available.

This test was carried out on a 64k Intertec SuperBrain running CP/M 2.2, with twin double-density minifloppy disk drives and an Epson MX-80 dot matrix printer. The version of Magic Wand tested had been specifically adapted to the SuperBrain and the computer itself had a set of special function keys replacing the normal numeric and cursor control keys.

Magic Wand comes as two separate programs: a text editor, with which you, prepare your text, and a text formatter, which types the text in a format specified by you during the editing stage.

Editing

The editor is called from CP/M simply by typing EDIT and the file name, which can be either a new file or one already existing. You can type a second file name on the same command line and the results of your efforts will then be saved under this second name, which is useful if you want to leave the original file unaltered. Otherwise, Magic Wand saves text under the first file name and preserves the original file as a back-up.

Once the editor has been loaded, you're asked to insert the disk holding — or to hold — the text file and if the editor can't find the named file on the disk it asks you to confirm that you're working on a new file; this ensures that you'll notice if you intend to work on an existing file but had accidentally inserted the wrong disk.

You then find yourself looking at the command screen, which shows you what files are in use, the number of words and characters in the text buffer, the number of characters remaining and the current line length and tab positions.

A range of commands can be executed from the command screen, most of which are activated by only one or two letters. Typing an illegal command or a '?' causes a menu of all commands to be displayed; typing a command followed by '?' provokes a terse, single line explanation of the command.

Having set up the screen line length and any tabs you need, you move from the command page by pressing return. If you're working on an existing file, you find yourself at the top of text; with a new file, the screen blanks disconcertingly — the electronic equivalent of a fresh sheet of paper!

The Magic Wand editor provides all the facilities one expects from a good screen-oriented word processor. There's no need to hit return when you near the end of a line as the system has automatic word wrap-around — if the whole word won't fit onto the line, it's completely transferred to the start of the next line, which aids readability tremendously. Not pressing return takes a little getting used to but it speeds up editing significantly; you can, of course, use return to force an end of line — at the end of a paragraph, for instance.

Special function keys are provided for all the inserting and deleting. You can insert/delete a character at a time simply by positioning the cursor at the appropriate place and pressing the required key; the line is opened or closed automatically on the screen as you type. A 'full insert' key opens up several lines on the screen to allow you to type in large chunks of text — the mode is cancelled by hitting the same key again. Other keys allow you to scroll back and forth both a line and a page at a time, while another pair provides an instant jump to either the top or the bottom of the text.

Search and replace commands are provided via a special key; pressing it drops the cursor to the bottom line of the screen and you type in the strings to be searched for/replaced on this line. Search/replace operates on the text between the cursor position and the text end. A repeat search key is provided and is self-explanatory. Replace will take place on all occurrences of the specified string or on a specified number of occurrences; a query option is available, which allows you to miss out some occurrences if you wish.

Two commands deserve special mention. The Include command allows you to specify a file and incorporate all parts of it into your text. Thus you can have a file of standard paragraphs on disk and select from them as you compose your text. The system displays the text to be included and gives you the option of either slotting it in or moving on to other parts of the Include file.

Spool enables you to print and edit simultaneously. Having edited one file and saved it on disk, you can then get on with editing another, using Spool to print out the first one. The theory's fine but I found it nearly unusable since the system gives priority to servicing the printer with the result that response to the keyboard slows down dramatically, to well over a second between pressing a key and the character appearing on the screen, in some cases. It's pretty debateable whether using Spool would actually save you any time.

The block commands are straightforward but only allow you to have one block active at a time. Yes, there's a special key to insert block markers but these have to be deleted by returning to the command screen and using a special command after you've carried out your block operation.

The editor allows you to print a draft copy of your text; the printout is exactly what you see on the screen, which means that any embedded formatting commands (see below) are printed instead of being executed.

The text buffer holds 37,633 characters, just over 6000 words or 13 single-spaced A4 pages. Once the buffer is full (you're warned in advance) you must save the text to disk and continue on a new file. Magic Wand won't handle a file which is larger than the text buffer. If you're working on very long texts you may find this a trifle annoying as you'll have to split text into chapters or sections; it does mean, of course, that while you're working on chapter nine you can't zip back to chapter three to check what you said there. On leaving the editor, you are given the choice of saving the text on disk, either as a new file or as an update to an existing file, or of simply quitting without saving the text.

Formatting

Having prepared your text with the editor, you must first save it on disk before running the formatter program, which is called simply by typing PRINT followed by the file name.

At this point an annoying inconsistency manifests itself. Once again,

Magic Wand invites you to mount the disk containing your text file and press return. However, the formatter has no equivalent of the editor's command screen so, assuming the text disk is mounted, printing starts immediately after you hit return. Printing can, however, be aborted and you can start all over again, this time prepared for the fact that instead of hitting return, you can also enter commands: one allows you to preview the formatting instructions embedded at the start of the text and alter them if necessary, although if other commands occur later in the text, they will be executed when the formatter gets to them.

As well as entering the formatting commands after calling the formatter, you can also insert (embed) them into text during editing; they are separated from the actual text by the '\' character. If you happen to want to print that character, you can define a different character (or no character at all) as the command recognition character. Various other characters with special meanings, such as '&' for ghost hyphernation, can also be changed at will at any time in the text file. The formatting commands themselves can be entered either as abbreviations or in full to make them readable to less experienced users.

Magic Wand has some very sophisticated formatting capabilities as well as the usual ones provided by most word processing systems. Thus you can not only specify either justification (both margins even) or range right (ragged right margin, as produced on a normal typewriter) but you can print out range left, with the right margin lined up and the left margin ragged, a sort of 'mirror image' to normal typing!

The system gives you total control over the page layout, although there's a minor, initially annoying inconsistency with the margin commands: lm10 sets the left margin at the tenth column of the page but rm70, instead of setting the right margin at the 70th column, as in most systems, actually sets the *line length* to 70 characters, so the right margin is the 80th column. Top and bottom margins can be defined and you're given the ability not only to paginate but to place the page number anywhere you want to, even half-way through the text if you so desire. Magic Wand caters for text and paragraph indentations and allows you to centre lines or whole blocks of text between the margins. You can produce both page headings and footings of however many lines you require. Line spacing can be set to any number from one to six.

An extensive range of commands is available to control the printer. These range from a simple OUT command, which enables you to send out any ASCII control codes you like, to some very sophisticated commands for equally sophisticated printers, the expensive sort with proportional spacing, bolding, underlining, super- and subscripting capabilities, etc — Magic Wand caters for all these features. This allows you to produce justified text where the justification is achieved by varying the spacing between letters rather than by adding spaces between words, as is done with cheaper printers. Using Magic Wand with an expensive daisywheel printer, you could easily produce camera-ready artwork for printing

```
                    Edit System Status

Reading   Active    SAMPLE2
Updating  Active    SAMPLE6
Including Active    WORKOUT
Printing  Inactive  SALUTES

WorkSpace contains 48 Lines/Paragraphs  340 Words

    Characters:  37633-Total   2005-In Use   35628-Remaining

Mode: Text
Line Width: 80

Tab Columns: 1 9 17 25 33 41 49 57 65 73

*?
Commands are Read, Write, Include, Filelist, Kill, DisPlay,
Change inPut, eXtract (X to backuP, X=filename to extract),
Block, Print, SPool, Mode, Tab, Linesize, END, and QUIT.
Type the caPital letter only, followed by any additional
data required, or by '?' for more information.

*
```

The editor's command page (see text). Shown at the top are the input and output file names; part of another file ('Workout') is being included and a fourth file is being printed in the background. Also shown is the commands 'help' menu.

which would feature some extremely sophisticated formatting and be virtually indistinguishable from properly typeset work.

Other commands available include: a draft facility, which allows you to print a file containing speciality printer commands onto a faster dot matrix unit so you can check the formatting; the choice of printing onto continuous stationery or of pausing after each page to allow the insertion of single sheets into the printer; and the ability to print multiple copies of the same document, with or without a pause between copies.

As the Epson doesn't permit variable spacing between letters, justification was performed by adding spaces between words and Magic Wand seemed to do this particularly intelligently, frequently inserting the extra spaces after full stops or in the middle of lines instead of just at one end of the line; the result is a very neat printout.

Various facilities are included to make life easier for the operator. You can insert comments into the text file which will not be printed during formatting; NOTE prints a message to the screen only; WAIT stops the printing and waits for a command to be typed in (you can add a prompt which will appear on the screen); and SHOW prints on the screen the current values of any variables (see below) you specify, together with whatever explanatory text you require.

Summarising, the Magic Wand formatter is extremely powerful, as powerful as any user is likely to require without having resort to full typesetting facilities; it enables the user to produce simply-formatted documents with great ease and complex formatting with little extra effort.

Files and variables

If the features I have described so far were all that Magic Wand offers, it would still be a powerful tool for many

in the form of the provision for variables with accompanying commands which are on the verge of being a programming language, plus the ability to set up files which can be referenced by Magic Wand as it is printing text.

Files are set up using the editor as though they were pieces of normal text. The files can be either 'data', such as names and addresses, together with other details such as the salutation used for each person ('Dear Mr Harris,' or 'Dear "Bumper",' for example) and any other details you require; or they can be paragraphs of text which you might wish to incorporate into standard letters to customise them.

There are four types of variable: string, numeric, formatted and system and you can have up to 128 variables in any one file. String variables can be up to 55 characters long (you can set them to shorter lengths to save on memory space) and you can reference the first n characters of a string. Numeric variables are positive integer only in the range 0 to 32767. Formatted numeric variables, used mostly for amounts of money, are printed out to two decimal places with commas — 10000.5 would be printed as 10,000.50, for example and you can set this to print out in continental format: 10.000,50.

These variables can have their values set in different ways: in the text file, using the SET command; from the keyboard when you run the formatter, using the GET command; or from a data file — it's this last capability which makes Magic Wand a very powerful tool indeed.

The system variables are for page number (the only one alterable by the

Condensed typeface
Condensed enlarged
Condensed double
Normal typeface
Normal emphasised
Normal double
Double typeface
Double emphasised
Double double

Fig 1 Sample typefaces from the Epson MX-80.

user), the pass number for when you're printing multiple copies of a document, the current file record number being accessed, an end of file marker, current line and column numbers and the number of lines left on the page. You can use this last to force a new page before printing a heading if there aren't enough lines of text after it — that way you avoid ending up with a heading on the last line of a page.

Coupled with the variables are conditional commands which allow you to test for a condition and act according to its value: IF NAME = "Fred", SKIP 4 would skip the next four lines if the value of the string variable NAME was "Fred", for example. So, you can get variables from a file of, say, names and addresses and print one of a variety of different paragraphs according to the variable's value.

You could use Magic Wand for many applications without ever using the variables feature; with variables, you have a word processor of great sophistication and power which would provide a very useful tool in a business environment.

Learning and documentation

As you will have gathered from the above, if you want to exploit the full potential of Magic Wand, you have a lot of learning to do. Fortunately, this is made very easy by what must be one of the best examples of documentation in the micro world.

The first two-thirds of the manual are a series of lessons which take you step by logical step through all of Magic Wand's abilities. The lessons use a series of text files which come on the disk with Magic Wand — you play the part of Abraham Lincoln's secretary, working on a draft of the Gettysburg address, which you have to polish and alter until the actual address results. You then go on to set up standard replies to various types of letters (from friendly to threatening) and a file of names and addresses so that each person gets the reply he deserves.

At each step you're given a photograph of what the screen should look like and reproductions of the printout produced by it. These are very useful for checking that you're actually doing what you're suppose to be doing.

The lessons are structured so that you can drop out at whatever level meets your requirements — there's no need to wade through files and variables if you want to use Magic Wand for straightforward text editing and formatting. Great care has been taken to explain any technical terms in full as they arise so that the complete novice can sit down with the manual and feel quite at home with the system from the start.

The final section of the manual contains summaries of the editing, formatting, files and variables commands. Two of the commands which appeared on the editor's command screen were nowhere explained in the manual but this apart, the summaries were well-written, logically laid out and easy to use.

The book also includes a brief introduction to CP/M, explaining all the features which are likely to be of concern to Magic Wand users.

Users

Because of its wide-ranging facilities, Magic Wand should prove useful to all four of our 'standard' users (outlines in the introduction to this series last month), although some of them would have to accept certain limitations.

The text buffer capacity of just over 6000 words could be regarded as a handicap unless you accepted the minor inconvenience of working by chapters and storing them as a series of separate files. The author/journalist would be most affected by this feature and in fact this user would be unlikely to make use of many of Magic Wand's capabilities, especially the files and variables facilities. On the other hand, many authors would find the hardware/software configuration attractive — Magic Wand is easy to learn to the level required for this use and the SuperBrain, with its integral construction, sits tidily on a desk. The Epson is a very civilised little printer for this application.

For the report writer there's again the 6000 word limitation but this is probably less of a problem than for the author. Again the report writer would probably not use the package's more sophisticated facilities but the very extensive formatting features would be of immense value in this application. Coupled with a high-quality daisywheel printer (the Epson would be useful only for rough drafts to check formatting), Magic Wand should fulfil most report writers' needs.

The manager would also find Magic Wand useful, although he would certainly use only a few of its capabilities. His requirement for quick and easy learning is more than met by the excellent manual and, of course, the extra facilities are still there for him to get to grips with for urgent work on the secretary's day off. The Epson would be at home in the manager's office for draft work since it's neat and unobtrusive.

In the introduction to this series, I said that the secretary is probably the most demanding of all four users. Magic Wand has been devised quite clearly for use in a busy commercial environment and would meet most requirements in this area. The system is friendly and foolproof but it's probable that, to make use of its full facilities, the secretary would want to go on some kind of a course — although the manual is certainly sufficient, a busy office is hardly the place to sit and learn the advanced features Magic Wand offers.

Hardware

The SuperBrain was Benchtested in *PCW*, August 1980 so I shall not go into its technical features and will concentrate on its suitability for word processing.

Firstly, the keyboard felt a little flimsy to me — the keys have a very light touch and a rather tinny feel to them.

The display was quite civilised, having a matt-finish screen to cut down reflections and a brightness control at the back of the machine. The character set is a little odd; characters such as 'g' and 'y' have proper descenders but these don't actually descend — instead, the characters are raised so the bottom of the descender aligns with the bottom of other characters. The overall effect was most graphically described by Sue Eisenbach in her Benchtest as 'vaguely ransom note' but the novelty quickly vanishes and after a couple of hours I didn't even notice it.

The disks each have a capacity of 179 kbytes, about 25,500 words or 56 A4 pages (single spaced), which is probably adequate for many people. The disk drives on the model I tested were permanently running — this creates noise (not too much) but, more importantly, increases wear both to the disks and the drives themselves. You can reduce disk wear by removing the disks once you've loaded the programs and text but drive wear might prove a problem. Some models of the SuperBrain have been modified to turn off the drives when they're not required so this problem won't apply to those.

Any cheap printer with an RS232 interface will plug straight into the SuperBrain's auxiliary port. Another RS232 port is provided which makes linking to other computers, directly or via modems, quite easy. High quality daisywheel printers can also be hooked up and, because the SuperBrain comes all in one box, there'll be a minimum of trailing wires to trip over in the office.

The special function keys which replace the SuperBrain's usual numeric and cursor control keys make the whole system very easy to use but at £50 they're very over-priced.

The Epson MX-80 is a very nice printer. It's very well made, as one would expect from Japan these days, is compact, light and very quiet. As the Benchmark results show, it's not particularly fast despite its bidirectional printing but the print quality is very good, as shown in Figure 1. Quite a variety of typefaces are available by sending sequences of control codes; of these, the emphasised condensed gives very dense, black characters which would, at a pinch, pass for correspondence quality for those not-too-vital

letters. By changing switch positions inside, you can get standard ASCII, English, French, German and Japanese character sets, the European character sets differing in that the English set gives a '£' sign instead of '#' and the others provide accents and umlauts. TRS-80 graphics are also in there, unless you set up for Japanese characters, which replace most of the graphics. Depending on which character set you choose, the Epson prints over 40, 66, 80 or 132 columns and takes paper from 4in to 10in wide. I tested the F/T version, which has both pin and friction feed; these mean that, by disabling the paper-out sensor (with a special control code or a screwdriver), you can print on single sheets. The printer will accept one original plus two carbon copies. It uses a cartridge ribbon which is very easy to fit and the print head can also be replaced by the user — the manual tells you how to do it and replacement heads cost about £15. The bell, incidentally, is *very* loud.

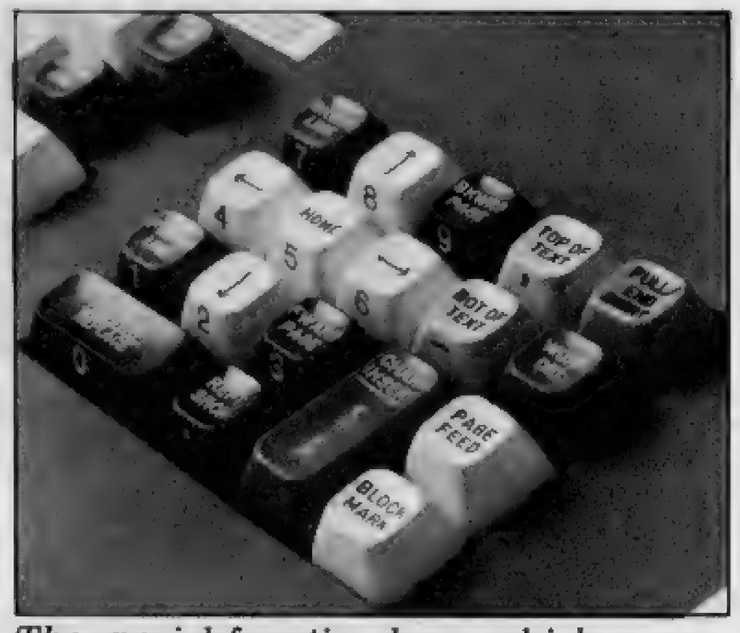
Summary

Magic Wand is designed specifically for commercial use and as an office tool it's a winner, providing a wide range of extremely powerful facilities. The secretary will be its heaviest user but the report writer will also find it very useful for its powerful formatting capabilities.

Thanks to the excellent manual, most users should have no trouble in learning the system to whatever level they require.

Coupled with Magic Wand, the SuperBrain is very good for word processing, especially when fitted with the special function keys, which make a major contribution to the system's ease of use.

The Epson is a very nice printer, certainly one of the better low-cost dot matrix printers on the market today. For draft or manuscript production it's ideal, but serious users will require a daisywheel unit to produce correspondence and report quality material.



The special function keys, which replace the SuperBrain's numeric pad.

WP Benchmarks

Magic Wand/Intertec SuperBrain

WP Test*	Base	Buffer full	DF1 (n=2)
1	24.5	37.3	0.7
2	24.3	39.5	0.8
3	1.2	1.3	0.5
4	1.0	1.7	0.9
5	3.0	5.5	0.9
6	3.1	5.9	1.0

All times in seconds

Epson MX-80 F/T printer test*

Claimed printing speed: 80 cps
Tested speed: 45 cps (485 words/minute)

* See April 1981 *PCW* for details of WP Benchmark tests

Prices (excluding VAT)

Intertec SuperBrain, 64k RAM, twin 5¼in disks:	£1595
Special function key set:	£50
Epson MX-80 F/T printer:	£399
Magic Wand:	£250

Our thanks to the London Computer Centre for the loan of the hardware and software for this review.

COLOUR CONVERSION

CHECKOUT

John Nuttall tests an add-on which brings colour graphics to the PET.

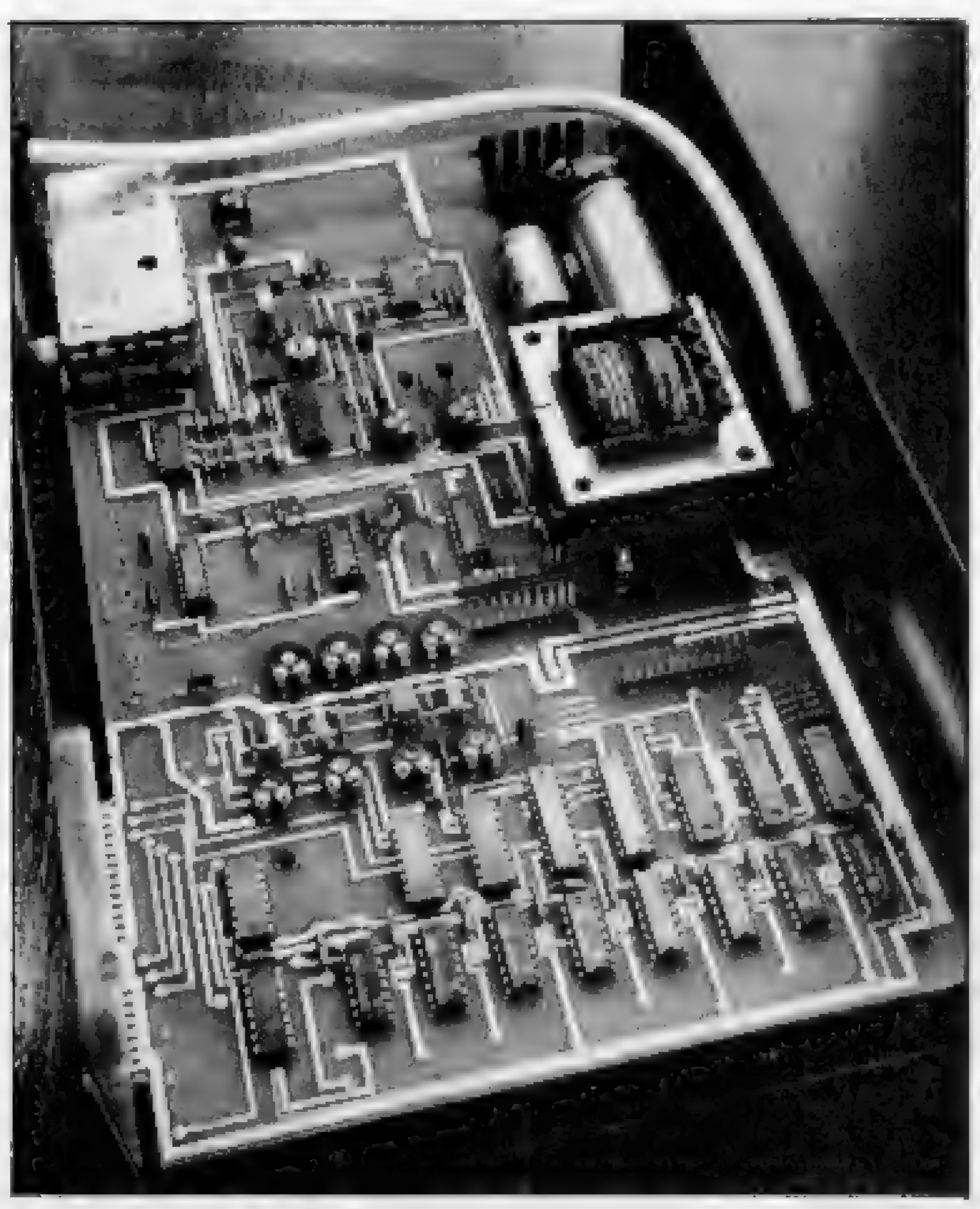
The full PET and Chromadaptor configuration

Hands up all PET owners who have ever cast envious eyes at Apple's colour facilities. And how many even contemplated changing machines? Now, with the advent of a box of logic from Sadektronics Ltd, PET owners can cease fretting and bring some colour to their screens! The Chromadaptor is an add-on box which will enable PETs to talk in colour to any TV without modification. As a bonus, you won't even need one of those expensive sound boxes — CB2 sound comes down the aerial, too, and exits from the TV's internal speaker.

The basic principle is this: each one of the thousand screen locations in a PET has a corresponding memory location within the Chromadaptor interface. These locations can be programmed with any two of the 16 colours available. One of the colours is background and the other is foreground. (On a standard PET screen the background is black and the foreground white — or green on later models.)

The interface is assembled, with its own mains power supply, in an attractive metal case. It comes with all the plugs and leads you'll require, though edge extenders are not provided. It is suitable for old or new ROM models and costs £295.00 plus VAT.

The instruction booklet, while not over-descriptive, contains the essentials for installing and running the product. First, the personality card has to be fitted inside the PET. This is designed to fit where the video RAM chip sits. If that chip is socketed, remove it, plug in the card and finally re-instate the chip in the socket on the card. If there isn't a socket, you have problems. The instructions recommend de-soldering the chip, but this is an awesome task even for the skilled: don't forget the main PET PCB is double-sided! Better to gently sweat-solder an IC socket onto and over the resident chip. The card will now fit and the ribbon cable can be attached. Plug in the user port connector and the one to the back of the Chromadaptor and finally the screened lead from the interface to the TV aerial socket.


Inside view

Now that the hardware is fixed, we can turn to the software. Before actually programming or running anything, I recommend spending a little time fine-tuning the TV. Programs are supplied for this, as well as border adjustment pots on the Chromadaptor to ensure that the picture is optimised. Study of these 'demo' programs will demonstrate how simple it is to program in colour.

Perhaps I should state that all existing black & white programs can be made to run in colour by switching the software control mode (remote) to local. Thumbwheel switches are provided to manually determine foreground and background. (I understand that these switches have been dropped from current production models of the Chromadaptor, which is a pity, but in either case a simple POKE command will do the trick.)

COLOUR	b/ground	f/ground
dark black	0	0
dark red	16	1
dark green	32	2
dark yellow	48	3
dark blue	64	4
dark magenta	80	5
dark cyan	96	6
dark white	112	7
black	128	8
red	144	9
green	160	10
yellow	176	11
blue	192	12
magenta	208	13
cyan	224	14
white	240	15

Table 1.

Programming in colour sounds frightening, but it isn't! It may be done from Basic (direct or programmed) or

```
0 REM *** DEMO FOR CHROMADAPTOR ***
1 POKE 59459,255  :REM OUTPUT CODE
2 POKE 59471,15   :REM COLOUR CODE WHITE ON BLACK FOR BORDER
3 PRINT"▯":FORI=0TO39:POKE 32768+I,42:POKE 33728+I,42:NEXT
5 FORJ=1TO25:POKE 32768+40*J,42: POKE 32807+40*J,42:NEXT
9 POKE 59468,14
10 PRINT"▮▮▮▮▮▮▮PETS IN BLACK & WHITE LOOK DULL"
15 FORI=1TO2000:NEXTI:REM DELAY
18 PRINT"▯"
50 PRINT"DISPLAY OF COLOURS"
60 FORI=0TO15
70 POKE 59471,I*16: REM COLOUR CHANGE LOOP
80 POKE 33528+2*I,32:REM POKE SPACE IN COLOUR
90 NEXTI
100 POKE 59471,207:PRINT"▮▮NOW YOU CAN COLOUR YOUR PET !
110 PRINT:POKE 59471,10:PRINT"▮AND ADD A NEW DIMENSION TO GAMES
120 PRINT:POKE 59471,13:PRINT"▮▮▮...OR BUSINESS PROGRAMS"
130 PRINT"▮▮":POKE 59471,06:PRINT"▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮"
140 PRINT:PRINT:POKE 59471,95:PRINT"WITH FULL COLOUR CONTROL...."
150 FORJ=1TO2000:NEXTJ:PRINT"▯":FORJ=1TO500:NEXT:GOTO2
160 REM ** DELAY IN LINE 150 BEFORE GOTO 2 GIVES MAGENTA SCREEN AS MAGENTA WAS
170 REM ** LAST BACKGROUND COLOUR COMMAND.
READY.
```

Fig 1

by machine code. I'm just starting a modest CEEFAX-like information package in colour for an exhibition. This was done in Basic, with machine code subroutines to change or flash colours.

You must first set up the colour output code, and this is normally done at the start of your program (see listing):
POKE 59459,X
if X = 255 then change both f/ground and b/ground as required;
if X = 240 then change b/ground only as required leaving f/ground white;
if X = 15 then change f/ground only as required leaving b/ground white;
if X = 0 then disable change of colour facility leaving white on white.

On power-up, the output code will be 0 and the colour code 255, which is white on white. If you are only using a colour TV this state of affairs means you won't be able to read anything, which is why I regret the removal of the mode select switches on new models! I've actually disconnected my VDU and replaced it with a Sony 16in television. However, you can run both the VDU and TV in tandem.

If the output code is 240, then only the background colour is effective. If the colour code (see below) is 27, code 11 is ignored and only code 16 is used. Similarly, if the output code is 15, then only code 11 is accepted. Both codes remain valid until changed. Once the output code is generated, you will need to select the colour code into the address 59471. This is done prior to POKEing or PRINTing characters or graphics (see Table 1).

So, POKE 59471,155 will produce a red background with a yellow foreground. The colour code is the sum of the numbers representing the desired background or foreground.

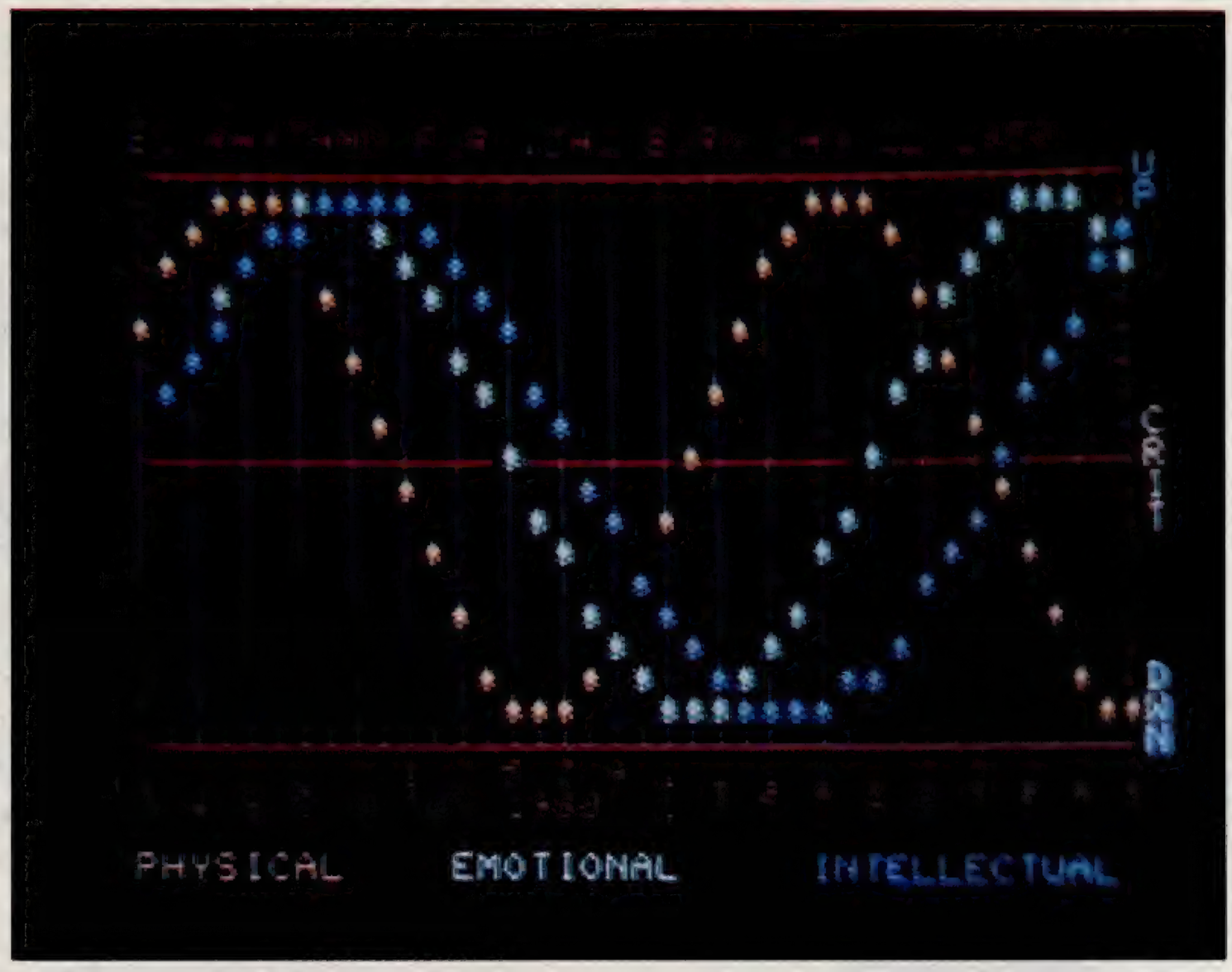
Figure 1 is a simple program to demonstrate some of the colours on a black background.

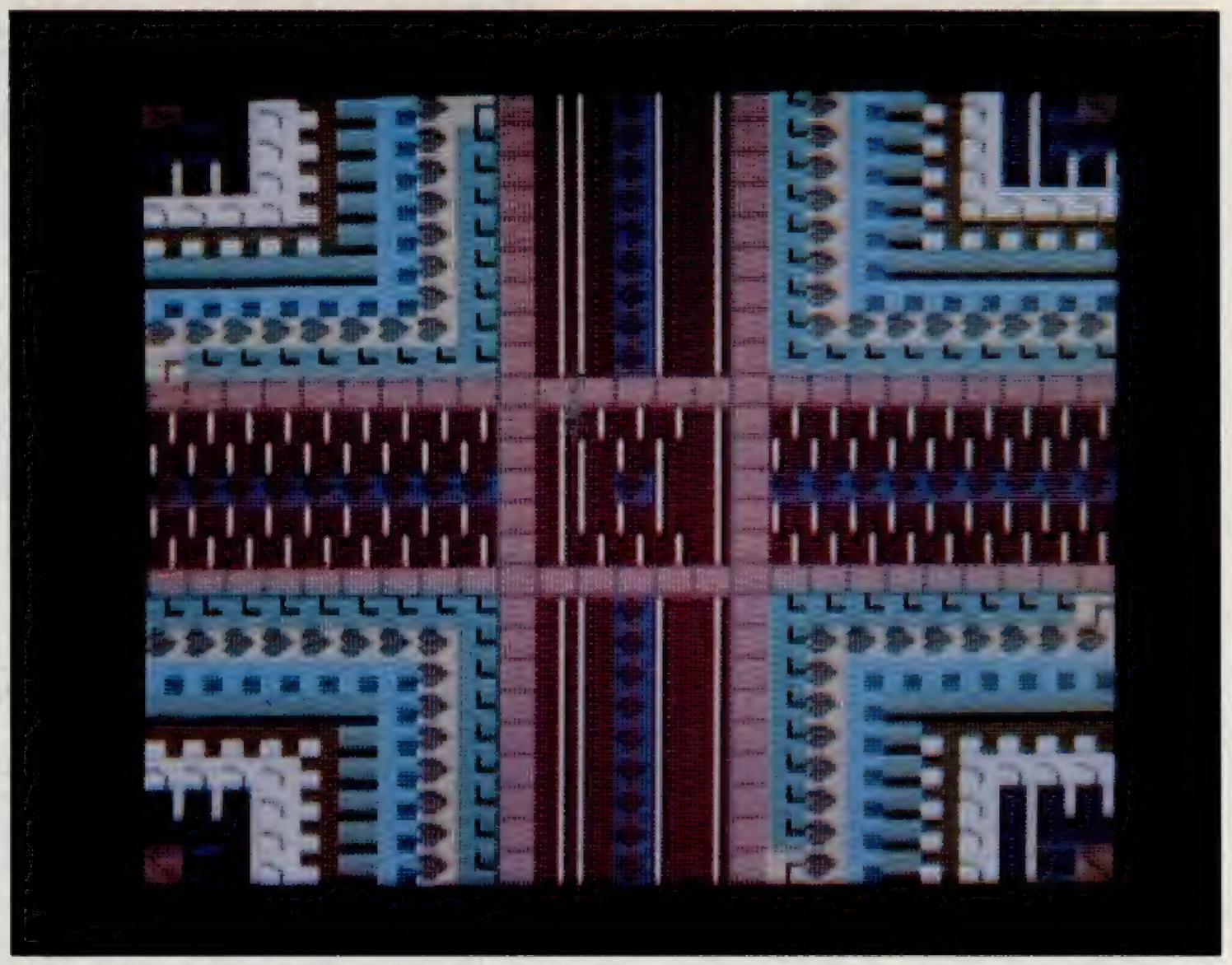
Final verdict

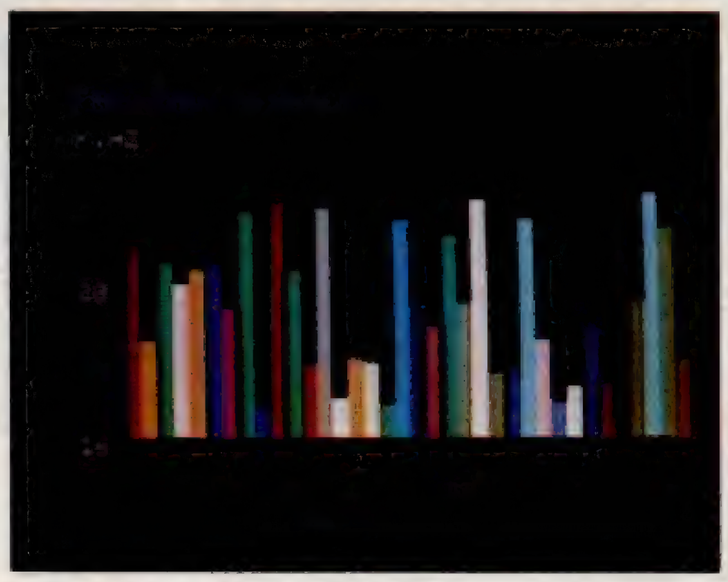
The quality of construction and display are splendid. This is one of the best TV interfaces I have seen, with none of the shake and judder of lesser models. No doubt contributing factors are the design, especially of the power supply, and a good 8 MHz modulator. While the picture is rock steady, there is a slight halo effect with colour. Selection of background and foreground needs care, otherwise you'll end up with hatching. Perhaps a professional monitor, or taking the signal to the TV's gun would obviate the problem. An RGB outlet is provided for such a connection. That said, listings are legible and editing easy.

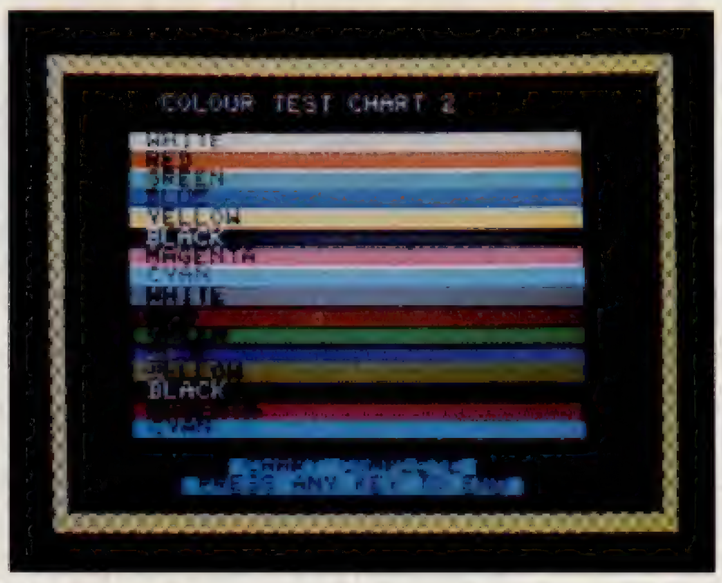
The manual mentions a colour chip and, although this isn't available yet, it could make colour programming more direct. No doubt there will be a time penalty for program execution. The Chromadaptor isn't cheap, but it does the job very well and answers a real need. It is also Commodore-approved. For those with tight budgets, you might consider the Monadaptor at £45.00 + VAT, which plugs onto the user and cassette ports and is of good design.

This product could be a useful item in schools, where the output might drive a 26in TV. That should solve the problem of 20 bodies huddled round a PET! Businessmen might have a look at the Banner program which comes with it, and is a sort of 'telecaster' for messages in large print. It's somewhat different from the usual display program in that it scrolls from right to left and, of course, in colour. Some clever stuff here!









Some examples of the Chromadaptor's abilities.

Available from: Sadektronics Ltd, 1 Northwest House, 45 West St, Brighton, Sussex. Tel 29949.
Cost: £295 + VAT.
Package: Chromadaptor, personality card, disk or cassette of sample programs, leads and connecting ribbon cable, manual.

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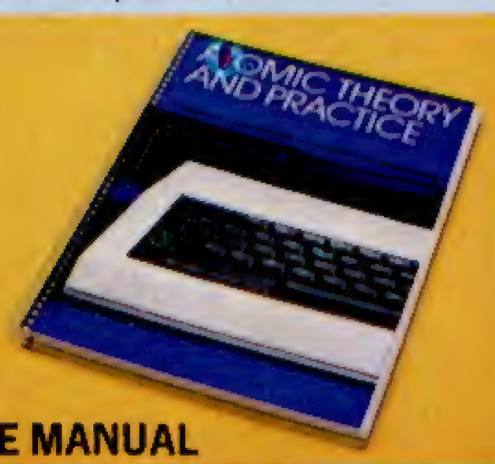

FREE MANUAL

Free with every ATOM, kit or built, is a computer manual. The first section explains and teaches you BASIC, the language that most personal computers and the ATOM operate in. The instructions are simple and learning quickly becomes a pleasure. You'll soon be writing your own programs. The second section is a reference manual giving a full description of the ATOM's facilities and how to use them. Both sections are fully illustrated with example programs.

The standard ATOM includes:

HARDWARE

● Full-sized QWERTY keyboard ● 6502 Microprocessor ● Rugged injection-moulded case ● 2K RAM ● 8K HYPER-ROM ● 23 integrated circuits and sockets ● Audio cassette interface ● UHF TV output ● Full assembly instructions

SOFTWARE

● 32-bit arithmetic (±2,000,000,000) ● High speed execution ● 43 standard/extended BASIC commands ● Variable length strings (up to 256 characters) ● String manipulation functions ● 27 x 32 bit integer variables ● 27 additional arrays ● Random number function ● PUT and GET byte ● WAIT command for timing ● DO-UNTIL construction ● Logical operators (AND, OR, EX-OR) ● Link to machine – code routines ● PLOT commands, DRAW and MOVE

The ATOM modular concept

The ATOM has been designed to grow with you. As you build confidence and knowledge you can add more components. For instance the next stage might be to increase the ROM and RAM on the basic ATOM from 8K + 2K to 12K + 12K respectively. This will give you a direct printer drive, floating point mathematics, scientific and trigonometric functions, high resolution graphics.

From there you can expand indefinitely. Acorn have produced an enormous range of compatible PCB's which can be added to your original computer. For instance:
● A module to give red, green and blue colour signals ● Teletext VDU card (for Prestel and Ceefax information) ● An in-board connector for a communications loop interface – any number of ATOMs may be linked to each other – or to a master system with mass storage/hard copy facility ● Floppy disk controller card. For details of these and other additions write to the address below.

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COMPUTER GAMES

BRIDGE

by David Levy

Contract Bridge is one of the most interesting and skilful of card games, ranking alongside poker in its complexity. Many computer programmers are also bridge enthusiasts, so I expect that many of my readers will, at some time or another, have considered the possibility of writing their own bridge program. Let me warn you from the outset — this is a most daunting task. I would expect a competent programmer to take three times as long to write a bridge program as to write a fairly respectable chess program, and the size of the bridge program would be much larger — with less than 32 kbytes you might as well forget it. But since most of you who own or have access to computers *will* have at least 32k at your disposal, writing a bridge program is a task that can be undertaken by anyone who is prepared to devote a lot of time and effort.

In writing about computer bridge I shall attempt only to outline some simple principles which will enable the reader to write a working program. The game is sufficiently rich in ideas that stronger bridge players will be able to extrapolate from my article and include a number of more advanced concepts in their programs. Anyone who writes a 'simple' bridge program based on these articles will be able to enjoy an undemanding game without the need to find three other (human) players.

How to play bridge

I do not wish to go into a detailed description of the rules of the game, but some of my readers may not know how to play, so some explanation is essential. This will also enable those of you who play other bidding games to learn the principles of programming the bidding phase, which can be carried over to other games. The principles of playing the cards might also be useful in programming other games which are based on taking tricks. So don't give up if you are not attracted to the idea of programming bridge — what you learn here may help you in other games.

Contract bridge is played by four players, who form two partnerships. A normal deck of 52 cards is used, and at the start of a hand each player is dealt 13 cards. The players start by bidding for the right to play the hand, and whichever side makes the highest bid then tries to make the number of tricks indicated by that bid. If the

Illustration Ingram Pinn

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partnership is successful in making the desired contract it scores points according to the size of the bid, and the number of extra tricks (overtricks) made by the partnership. If the contract is not made, the partnership which was playing to make the contract loses penalty points, the number of penalty points depending upon the number of tricks by which the contract failed, and whether or not the defending partnership decided to 'double' the contract (doubling, as one might expect, doubles the number of points gained or lost on a hand, and also affects bonus points which can be scored in certain situations).

The player who deals the cards opens the bidding. He may say 'pass' or 'no-bid' if he doesn't wish to make a positive bid at this stage, or he may make a bid of the form 1 Club, or 2 No Trumps — the number part of the bid indicates the number of tricks that must be made if this bid is the final contract (number of tricks = number bid + 6); the suit part of the bid indicates what will be the trump suit if this bid is the final contract.

After the first player has made his bid or passed, it becomes the turn of the player sitting to his left. This player may also pass; or he may make a higher bid; or he may double the opponent's previous bid. In order to make a higher bid he must indicate a greater number of tricks, or he must bid a higher ranking suit (or no-trumps) than the previous bid. The ranking of the suits goes (from lowest to highest) Clubs, Diamonds, Hearts, Spades and then comes No-Trumps. So one Heart is higher than one Diamond; one No-Trump is higher than one of any suit; and two Clubs is higher than any bid at the one level.

The bidding proceeds in this way, moving round the table in a clockwise direction and coming to an end only when three successive players pass. Even if a player doubles or redoubles an opponent's bid, there must then be three successive passes before the bidding is at an end. Once the bidding is over, the players who won the bidding (ie made the final bid) are obliged to play the contract, or to be more precise, whichever of them first bid the suit (or No-Trumps) of the final contract — he is the one who must play the cards for his partnership. He is referred to as 'Declarer' and his partner as 'Dummy',

The player on the declarer's left leads any card that he chooses and, at this point, dummy places all of his cards on the table, face up so that everyone can see them. From now on dummy has nothing to do until the hand is over. His partner, declarer, must play the cards for both of them.

The rules of play are very similar to those of Whist and many other trick-taking games. The player who wins one trick leads the first card to the next trick, and players must follow suit if possible, or if this is not possible they may trump a card if they possess any trumps. (In a No-Trump contract this is not applicable.) Cards rank in the usual order, from Ace, King, Queen and Jack down to 4, 3 and 2.

The bidding phase

The point of the bidding phase is to try to reach the optimal contract, partly by conveying information to your partner about the strength and 'shape' of your hand. In order to be able to determine what contract you and your partner should be playing, it is important for you to know something about each other's hand. This is accomplished by the bidding, but because every bid must be higher than the previous bid, a partnership does not have a completely free license to pass information back and forth during the bidding, as this would lead them into an impossibly high contract. So the most important thing to do during the bidding is to try to reach the ideal contract by conveying the maximum information about your hand in the most economical manner. Let us examine the bidding of a hand of bridge to see how information is conveyed.

			Spades: K 8 7 4 2 Hearts: 2 Diamonds: A J 9 5 3 Clubs: K 10		
Spades: 10 Hearts: Q J 10 7 6 Diamonds: Q 8 2 Clubs: Q J 4 3			N W E S		Spades: 9 5 Hearts: K 9 4 Diamonds: K 10 7 Clubs: A 9 8 6 5
			Spades: A Q J 6 3 Hearts: A 8 5 3 Diamonds: 6 4 Clubs: 7 2		

For the sake of convenience we usually refer to the four hands by the four points of the compass: North, South, East and West. We shall assume that West was the dealer, and that the bidding goes like this: (players' thought processes in brackets).
West: Pass (I have a weak hand);
North: One diamond (I have a stronger-than-average hand with two good suits. I shall bid the lower ranking suit first to give my partner a chance of bidding hearts at the one level);
East: Pass (I also have a hand that is no better than average, and since my partner is weak we will not have enough combined strength to make any contract);
South: One spade (I have two biddable suits, but I have more spades than hearts so I shall bid spades first);
West: Pass;
North: Two spades (My partner has at leat four spades in his hand so we at least nine spades out of 13 between us. Obviously spades will be a good suit for us to play a contract in);
East: Pass;
South: Three hearts (I must show my partner that I have another biddable suit);
West: Pass;
North: Three spades (My first spade bid indicated only that I had reasonable spade support for my partner. Now I should tell him that I have more than minimal spade support and that I do not have enough strong cards in the unbid suits to make a no-trump contract possible);
East: Pass;
South: Four spades (My partner has at least four spades and probably holds the king of spades. He also has four or five diamonds so he does not have many clubs and hearts. I have the Ace of hearts so we are unlikely to lose more than one heart trick, and I only have two clubs so we cannot lose more than two club tricks before I can trump any further clubs that are led. So we ought to be able to avoid losing any more than three tricks, and four spades seems quite possible);
West: Pass;
North: Pass (Enough is enough);
East: Pass.

The above bidding and thought processes represent an over-simplification of what was going on in the minds of the players. But it does serve to explain the type of thought processes that one goes through when bidding in a simple fashion. I ought perhaps to mention at this stage that by reaching certain contracts a partnership may qualify for a 'game bonus' if the contract is made. These game contracts are: 3 No-Trumps; 4 Hearts or 4 Spades; 5 Clubs or 5 Diamonds. Making a lesser contract allows you to score the game bonus later on if you can make another contract that counts, together with the earlier contract, for enough points to make a game. I will not go into the scoring system in this article, but you should study an elementary book on bridge before writing your program, so that the scoring will be correct.

In order to make the bidding phase easier and to ensure that information is conveyed economically, various bidding systems have been invented. In a bidding system, each bid has a fairly precise defined meaning, and by correctly interpreting a bid, a player will understand more about his partner's hand. One useful tool employed in many bidding systems is what are known as 'high card points'. This points method usually counts 4 points for holding an Ace, 3 for a king, 2 for a queen, 1 for a jack or singleton (a suit with only one card, other than an Ace), 4 for a void (a suit with no cards), 1 for each card after the first five in a suit. Using this point count method, various rules of thumb have been developed, including:
a) Do not open the bidding with fewer than 12 points;
b) If you hold 12-15 points you should open one of your best suit.
c) If you hold 16-18 points you should open one No-Trump.
d) In order to make a three No-Trump contract the combined hands should have not less than 24 points, preferably 25 or more.

The above rules can all be broken, under the correct circumstances and, in fact, the same bid can mean many different things in the same situation, depending on which system of bidding

the partnership is employing. The most important thing to remember about bidding is that bridge is a partnership game, and you should be trying to help your partner during the bidding by making meaningful bids that he will understand. There is no point in making a brilliant bid on one bidding system if your partner is using a different system — he will not understand what you mean and before you know what is happening you and your partner will have overbid, and found yourselves in an impossible contract.

How to program a bidding system

Before writing your program, decide what bidding system will be used in the program and make a long list of what the various bids can mean in different circumstances. Whenever the program must make a bid it determines the circumstances and makes the appropriate bid. Whenever the program must interpret a bid made by its partner, it determines the circumstances under which the partner's bid was made, and then looks at the list of bids to see what the particular bid should mean in those circumstances. These two processes, the making of the correct bid and the interpreting of the partner's bid, can each be aided by keeping a number of important variables and updating them in the light of new information transmitted or received. The following variables might usefully be employed when deciding what bid to make or when interpreting a bid made by one's partner:

Max Clubs (what is the maximum number of clubs that have been shown so far by the player who is bidding this hand);
Min Clubs (the minimum number of clubs shown by the bidding);
Max Diamonds
Min Diamonds
Max Hearts
Min Hearts
Max Spades
Min Spades

By storing values for all the above variables, the program can build up an idea of the way in which the suits are distributed in his partner's hand, or he can keep track of the extent to which he has described the distribution of the suits in his own hand. In addition to knowing how long a suit might be, it is also very useful to have some indication as to how strong a particular hand might be.

This can be accomplished using two variables called Max Points and Min Points, which indicate the known limits of strength of a hand as indicated by the number of high card points in the hand. For example, if a partnership is using a bidding system in which 13 points is the minimum number for making an opening bid, a player who makes an opening bid is known to have at least 13 points so his Min Points is initially adjusted from 0 (the default value when the hand is dealt) to 13.

Adjusting the distribution variables is not a particularly difficult matter. At the start of a hand the four Max variables are set at numbers which may be deduced from the holding of the hand under scrutiny. For example, if the computer is making the first bid for West in the above hand, it sets Max Spades for North, East and South at 12, since it has one spade and knows that no other player may therefore have more than 12. Similarly, Max Hearts is set at 8, Max Diamonds is 10 and Max Clubs is 9. The minimum values of the suit variables are all set at 0 since no bids have been made and therefore nothing is known about the distribution in each of the hands other than the program's 'own' hand.

If we follow through the bidding of the above hand again, assuming that the computer is playing South, we can see how easy it is to adjust the distribution variables for the other hands. (Here I shall make certain assumptions concerning the bidding systems employed by the N-S pair and the E-W pair.)

West: (West's Max Points is set to 1, as he would open the bidding on 12 or more). West's Min Points remains at 0.
North: One diamond (North's Min Points is set at 12, Max Points is set at 15, since with 16-18 points North would have opened one No-Trump, and with 19 or more he would have opened two of a suit.) Also, Min Diamonds is set at 4, the minimum number needed to bid, and Max Diamonds is set at 7, since with 8 he would have opened higher.)
East: Pass (East's Max Points = 11, Min Points = 0)
South: One spade (South, the program, has indicated that he holds at least 7 points, otherwise he would have passed. So Min Points = 7, Max Points = 11, otherwise he would have made a stronger bid to indicate that he, too, held an opening hand. Min Spades = 4 and Max Spades = 6, since with seven or more spades, South would have made a stronger bid than one spade.)
West: Pass
North: Two spades (Min Spades = 3, Max Spades = 5, since with six or more spades North would be able to bid higher in spades, and would have opened in spades rather than diamonds. Also Max Hearts = 4 and Max Clubs = 4, by subtraction from 13.)
East: Pass
South: Three hearts (Min Hearts = 4, Max Hearts = 6 and, by subtracting from 13, we find that Max Diamonds = Max Clubs = 4. Note that neither clubs nor diamonds can be longer than a four card suit, as this would have required South to bid the suit before now.)
West: Pass
North: Three spades (Min Spades = 4)
East: Pass
South: Four spades (Min Spades = 5)

This example is not intended to indicate exactly how the variables should be adjusted, nor is it intended to be complete in the summary of information conveyed by each bid. The sole *raison d'etre* for the example is to show the reader the type of information that can be gleaned from a bid, and how this information may be used to update some of the more useful variables. When you have decided on the bidding system that will be employed in your program, the method for updating each of the variables will suggest itself.

Special conventions in bidding

There are a number of special bidding conventions, each of which may be used in a particular situation. Often these conventions take the form of a question and an answer. For example, the Blackwood convention is a method of asking your partner how many aces he holds, and how many kings. This information is particularly useful if your partnership is hoping to make a small slam (12 tricks) or a grand slam (13 tricks). The asking bid in Blackwood is 4 No-Trumps, and the replies are:
5 clubs, when holding no aces (sometimes this reply is given when holding all four aces);
5 diamonds, when holding one ace;
5 hearts, means two aces;
5 spades, means three aces.

In order to ask how many kings your partner has you simply bid five no-trumps, and he bids the number of kings at the six level (6 clubs is 0 or maybe 4), 6 diamonds is 1, etc.

When the Blackwood convention is employed, the program can update variables such as: Number of Aces, Number of Kings, and the tri-state variables Ace of Clubs, Ace of Diamonds, etc, which can indicate yes, no or don't know, depending on what may be deduced from the bidding. For example, if you hold two aces and find that your partner holds the other two, you know which aces he holds and so you can set the values of the tri-state variables (Ace of Clubs, etc) accordingly. This detailed use of variables can be most helpful when making a slam decision.

Another popular convention is known as Stayman, and consists of a two club asking bid after your partner has bid one no-trump. The asking bid enquires whether partner has at least four cards in either hearts or spades (or both), in which case he should respond by bidding the appropriate suit (or the better suit if he holds at least four cards in each of the two suits). If the program asks this question of its partner, it can use the reply to update the variables Min Spades, Max Spades, Min Hearts and Max Hearts, according to the reply bid.

Deciding what to bid-a simple algorithm

When faced with the decision of what bid to make, a number of complex factors enter the thought processes of a good bridge player. Here we are discussing the problems of writing a relatively simple bridge program, and so we must try to employ a relatively simple bidding algorithm. I have devised such an algorithm, which lacks the subtlety of an advanced bridge player, but which ought to provide the computer with the ability to make bids that are reasonably intelligible and reasonably sensible. The algorithm applies to any bidding system, so you may choose any system that you like, preferably from a good book on bidding. One word

GOTO page 148

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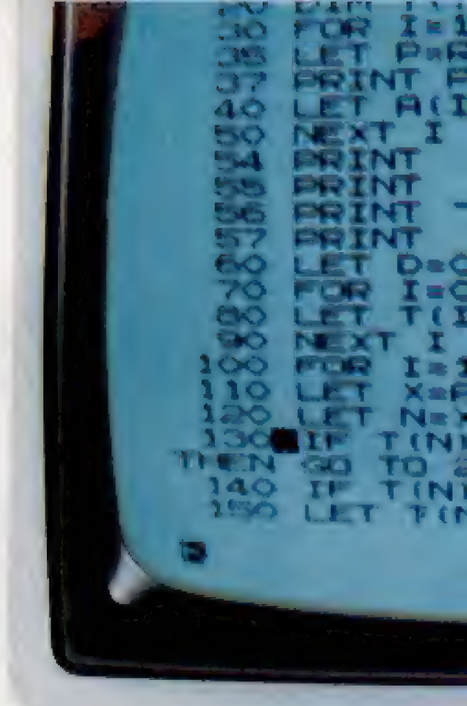

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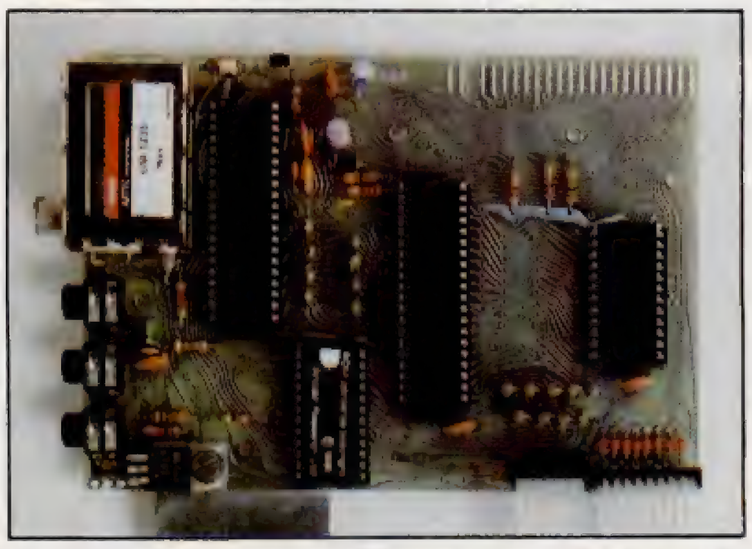

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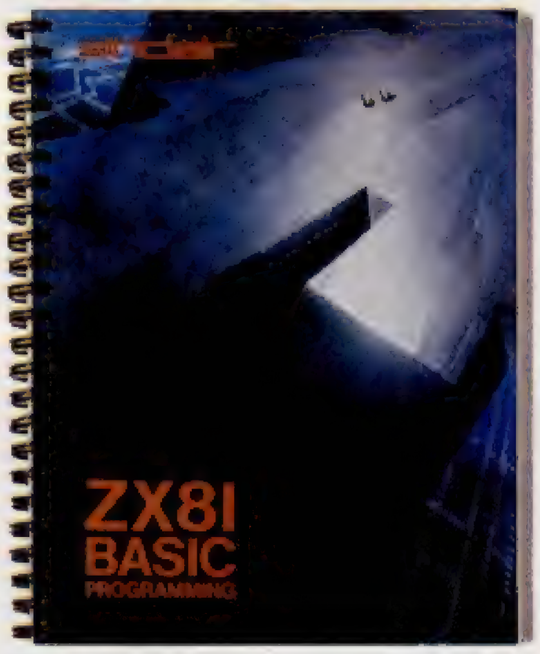
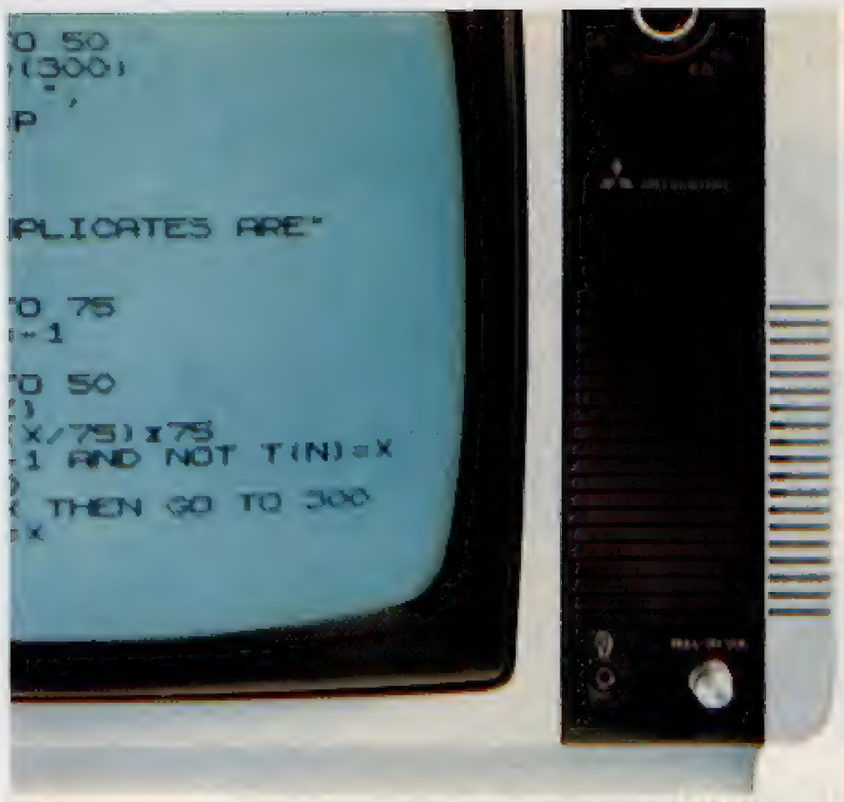


Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.



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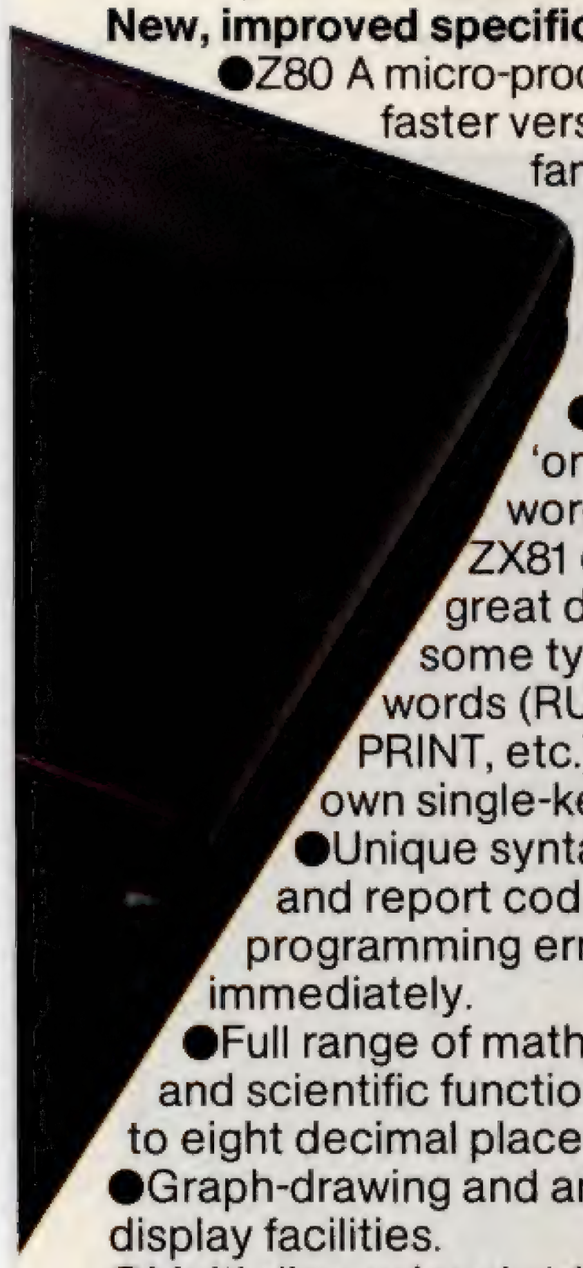

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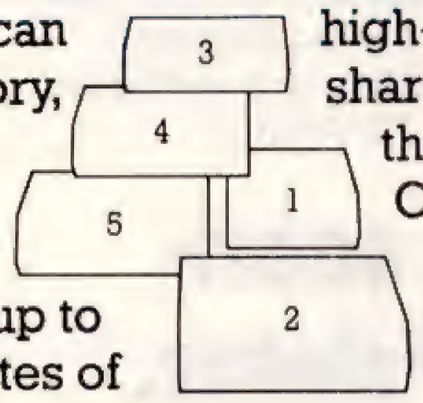

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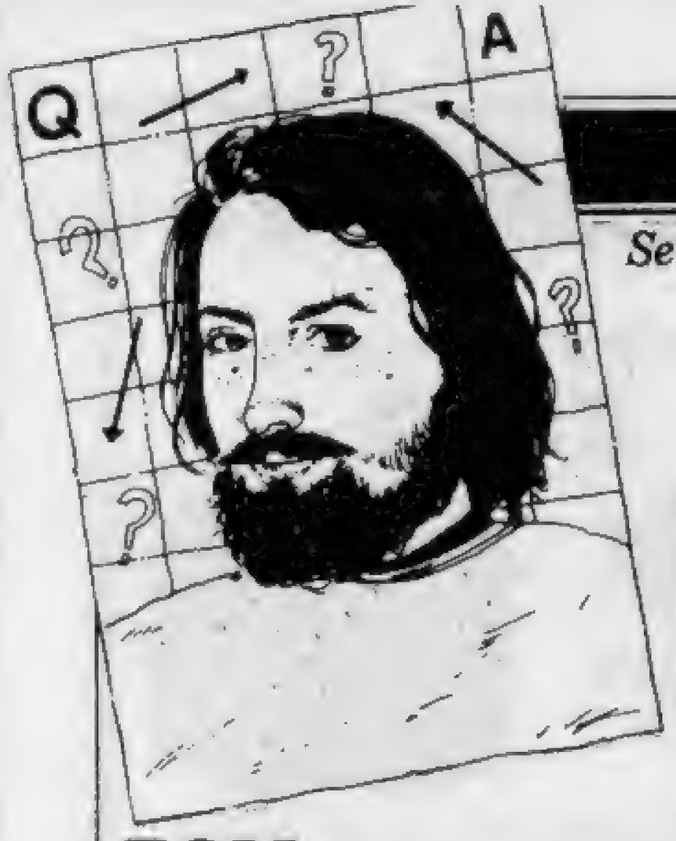

ROMs and RAMs

I would be grateful if you could answer some questions on chip compatibility:
1. Can static RAM be used as a replacement for dynamic RAM?
2. Can memory space be increased just by replacing one chip with another of a higher capacity?
3. Can unprogrammed ROM be used instead of RAM or does the first usage 'fix' it?
4. Can I replace the 2114s in my Micron with another chip to double the on-board memory space?
D Johnson, Merthyr Tydfil

1. In theory it can, but there are problems. First, static RAM chips aren't pin-compatible with dynamics, so you'd have to make a separate PCB on which to mount them. Secondly, you get fewer bits per chip with statics, so you'd have to make sure the addressing was reconfigured correctly. And lastly, static RAMs use more power so you'd have to check whether your system's power supply could cope. Incidentally, it isn't possible to use dynamic RAMs in a system designed for statics, as dynamics require a refresh signal which probably wouldn't be available, unless you built a circuit to provide it.
2. It is sometimes possible to fit larger-capacity memory chips into the same sockets as existing ones. However, you'd need to sort out the addressing; on some computers this is simply a matter of changing some links but with others it's practically impossible.
3. While the computer can alter the contents of RAM (and the contents are lost when the power is switched off), ROM has its contents permanently fixed, either during manufacture or, in the case of EPROMs, by an electrical process using a special programming device. ROMs are therefore useful for storing anything which you want to become a permanent part of the system (such as a monitor or, in some machines, a whole Basic interpreter) as it retains its contents when power is switched off. So, if you want to incorporate some software permanently into your system, you can use a ROM (actually an EPROM, which can be erased with ultra-violet light) provided you have access to a programming device. Unfortunately, ROMs and RAMs aren't pin-compatible so you'd have to build a board to house the ROMs.
4. Yes, it's possible to plug in other chips of greater capacity than the 2114s in your Micron but, as in 2 above, the addressing must be reconfigured.
P L McIlmoyle

Listings wanted

Where may I obtain a listing of a Basic, Fortran or Cobol interpreter?
J Mason, Hemel Hempstead

Try Lifeboat Associates or Interam Ltd. However, they are unlikely to supply you without you entering an agreement stating on which machine you consider installing the software and the estimated sales you envisage.

I assume that is *not* what you mean, though; remember that an interpreter is the result of a great deal of work worth many thousands of pounds, so a fully documented source assembler listing is not going to come free.

It is possible to dump the hex codes of an existing interpreter to a printer but you will then have to decipher them. Alternatively, you could get a disassembled copy which would be easier to read but still a long way from a documented listing.

Fortran and Cobol do not lend themselves to being interpreted and are usually compiled. I don't know of any such versions but I'm sure that someone will write if there are any.
SW

PEEK and POKE

I am experiencing a great deal of trouble understanding PEEK, POKE and USR functions on my system. I am getting on fairly well with Basic. Can I damage my computer by experimenting with them as I gather that they put things in, and take them out, of ROM?
G Nugent, Dublin; R Southern, Northallerton and others

PEEK, POKE and USR functions give you a way of looking (PEEK) at any memory location, altering it (POKE), and running a machine code subroutine (USR). None of these can physically damage your system, but random or unskilled use of POKE will almost certainly corrupt your Basic interpreter, Basic program, or some other critical routine, making your system crash sooner or later. Your letter says 'putting things in ROM'; just a small point but important nonetheless: you cannot put things (POKE) into Read Only Memory, you can only look at (PEEK) its contents. POKEing it will have no effect.

You can write machine code programs and POKE them into RAM from a suitable Basic program. As a machine code program runs more quickly than its Basic equivalent, this is particularly handy for things like animated graphics displays. You must, however, consult your computer's manual for details of where in RAM the machine code can be POKEd. Then you can activate the machine code program from Basic using USR. The format for USR varies from machine to machine but it's often something like USR(N), where N is the starting address of the machine code.

Using PEEK, POKE and USR will need a deeper understanding of your computer than Basic programming. It is not easy to go much further in a reply like this. Join a local user group/club as it is far easier to be shown than to have to struggle on your own.
SW

PET turn-off

How do you turn off/on the RUN/STOP key on a PET?
D Barnett, Barnsley

POKE X, PEEK(X)+3 where X=144 new ROM, X=537 old ROM turns it off, and POKE X,PEEK(X)—3 will turn it on again.
SW

Good for games?

I am interested in using a personal computer largely for games with moving graphics. Initially I have considered the Sinclair ZX80, but now appreciate that this cannot handle the moving graphics. Would the addition of extra RAM/ROM overcome this? As not many programs are yet published for the ZX80, would I be able easily to convert moving graphics programs in other versions of Basic for the Sinclair?

If the ZX80 plus extra memory still cannot be used, would you recommend the UK101? I envisage moving to writing my own games programs as soon as possible and would like to expand to a sound effects module, a cassette for storage and perhaps a printer. If neither the ZX80 nor the UK101 can meet my needs will I have to move up to the PET and Apple area?
D Booth, Nottingham

As you say, the ZX80 cannot handle moving graphics properly because the screen is blanked-out whenever the CPU does any data processing. Because of this it is not practicable to consider converting moving graphics programs published for other machines to run on the ZX80. However, I understand that this problem has been overcome with the ZX81 — and it's cheaper too!

The UK101 should be able to meet most of your requirements. The memory-mapped VDU handling and the ability to use machine code in conjunction with Basic both help with moving graphics. A sound-generator for the UK101 is currently being advertised by several companies and a circuit for one was printed in *PCW*, October 1980.

This also features a parallel I/O port which should help in interfacing a printer, should you wish to do this later. Should the UK101 not appeal, there are quite a few other machines in this general area to choose from without moving up into the PET/Apple level. These include the Ohio Superboard, which is quite similar to the UK101 (in fact the latter was based on the Superboard), the Aim 65, the Microtan and the Acorn Atom.
P L McIlmoyle

More garbage

Thank you very much for your helpful answer (in the January 'Computer Answers') to my question on sorting strings in relation to 'garbage collection'. My experience of this problem is with the Superboard II. Is it true that all versions of Basic have this problem, including Z80-based machines?
L Wood, Bourne End

Garbage collection is not a function of the processor but of the operating system and/or high level language. It is a problem which occurs with all versions of Basic but many

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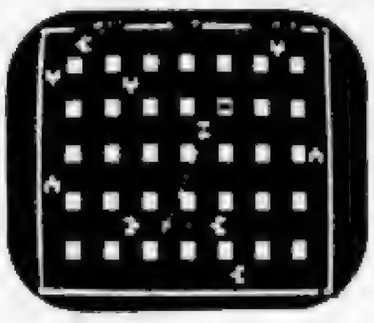

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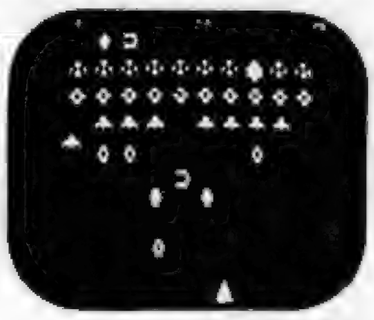

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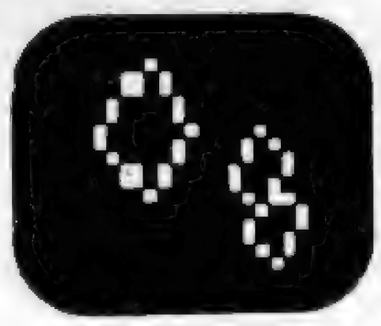

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of them deal with the problem so well that the user never appreciates that it's there. In many cases unused strings are allowed by the system to accumulate in memory until it starts to fill up. At the danger point the system initiates a garbage collection to free up memory. This entails much movement of data through memory and in a slow machine this can take a long (many minutes!) time. On fast machines the problem is not noticeable to the user but on some micros it can be most annoying.

There are solutions to the problem, apart from using faster processors like the Z80A running at 4 MHz. One is to force more frequent collections on the principle that 'little and often' is not noticeable. Another, fundamentally better, way is to make sure that the machine code garbage collection routines are really as efficient as possible. That careful attention to these points can pay off is shown by my having had no real problems with garbage collection delays when working with the bigger 8-bit microcomputers designed for commercial use.
P L McIlmoyle

48 OK for WP

I am thinking of buying a microcomputer for use as a simple word processor, as well as for more general home/business use. I suspect that a VDU line length of at least 64 characters is virtually necessary, which is a pity as I am otherwise considering an OSI Superboard C1E, which offers only 48 characters on a line. As journal editors usually ask for manuscripts to be double-spaced, would it be possible to replace each space on the screen by two spaces on the printer, thus turning the 48 characters into something like 56-58?

I am impressed by the advertised claims for the Cegmon monitor PROM for the Superboard. Would this combination be a better and cheaper solution than a TRS-80 Model I, level II?

Finally, what are the disadvantages, if any, of Stringy Floppies?
M H Bews, Liverpool

Your assumption is indeed correct, in as much as commercially available word processing packages for micros are concerned. These usually specify 64 characters to a line as a minimum, while 80 is the normal size for the screen, to allow for margins, etc. All this goes back to the normal commercial practice of typing on A4 paper, using a Pica type-face, at ten characters per inch. Using the other standard pitch (Elite, 12 characters to the inch), only aggravates the problem!

Of course, if your use doesn't need a standard business format, there's no reason why you shouldn't find 48 characters quite satisfactory.

By 'double spacing', editors refer to the space between lines not words; this makes it easier to edit copy — correcting spelling, altering to house style, etc — and most word processors provide a facility for varying the number of spaces between lines. Alternatively, some printers can be made to print with double line spacing, usually by an internal switch.

As for the Cegmon monitor for the Ohio Superboard, I have no actual experience so far (perhaps readers could send in their findings?). Certainly the Superboard set-up would be cheaper than a Level II TRS-80 Model I. But for your extra money you would be getting 16k of RAM rather than eight and a Z80 processor rather than a 6502. It is certainly arguable as to whether the processor makes any difference for your type of application but the extra memory is certainly an asset for word processing. Personally, unless money was the limiting factor, I would go for the TRS-80. If money was the problem, I would certainly think about the Video Genie before settling on a single-board.

Stringy Floppies have a lot going for them, very neatly filling the market gap between cassettes and 5¼in minifloppy disks. They will hold much more information than a cassette, retrieve it much faster and offer a much better read/write error rate. Disadvantages? Price for a start — a lot cheaper than a disk drive but still several times the price of a cassette recorder. Secondly, these units have to be designed to be compatible with the particular computer you're using. So far they are around for the S50 Eurocard, the S100 bus and the TRS-80/Video Genie computers. (Even then, there is one model for the TRS-80 and a different one for the Video Genie!) Lastly, they are not meant to be a replacement for disks, as they do not offer the speed or capacity of floppy disk systems.
P L McIlmoyle

HP speed-up

Having tidied up our programs and file handling on a Hewlett Packard 9830B as recommended in the February 'Computer Answers', we still need to speed up execution times. Are there no other possible solutions?
L W Huson, Ministry of Agriculture, Surrey

Firstly, to re-emphasise the points made in the February issue, not only is a compiler not likely to give the speed gains you are looking for but a full Basic compiler is not available for this machine and Fortran is not available on it at all!

However, there are some solutions, thanks to an American company called Infotek. They make replacement boards and ROM packs for the HP 9830 which can lead to programs executing some ten times faster, without any alterations to the programs. If you are using cassette data and/or program storage then some further time can be saved by using the Infotek floppy disk drive for the 9830.

The snag with these solutions to the speed problem is that, being based on hardware, they are relatively expensive, although still a lot cheaper than buying a faster computer.

These Infotek products for the HP 9830 are marketed in the UK by ISG Data Systems of Windsor, Berks.

You should also think of joining the HP Basic users club. The contact is: Nigel Stephens, Confederation Life, 50 Chancery Lane, London WC2.
P L McIlmoyle

Apple expansion

I own an Apple II (integer) with 48k RAM and tape input. I want to expand to be able to use floating point and word processing using an electric typewriter interface like the one supplied by Rochester Data. What is your advice on the best way to do this?
Thomas E Williams, SHAPE, Belgium

The most obvious way to expand to floating point is to use Apple's own Floating Point Basic or Applesoft. This can be obtained in several forms such as on disk or in ROM. Since you don't have a disk drive then the simplest approach is to buy the Applesoft firmware card and fit this. One attractive advantage of using this card is that you can have both Integer and Applesoft Basics resident in the computer and you can simply switch between them. This may be of particular interest to you as I expect that you may have many programs written in Integer so using this board enables you to run them easily.

As far as word processing is concerned, you should look through the various adverts that appear in the magazines for suitable programs — and read *PCW*'s word processor Benchtests! There are several programs, such as Apple's Word Processing package.

However, most of these will be on disk and if you are going to actively use your Apple for word processing then you should seriously consider buying a disk drive. This has the advantage that you can load in Applesoft into RAM and so avoid the expense of purchasing the firmware board, although you lose the previously mentioned ease of switching between the two boards.
M Dennis

Photo micro

I am an amateur photographer and would like to do my own processing. Is it possible to put the following applications on any micro and, if so, is the NewBrain suitable?
a) build an exposure meter for darkroom use and instead of wiring in a meter, input the voltage to the analogue input.
b) use the micro to turn various devices on and off at programmed intervals (I read 'A Switch In Time' in the August *PCW* and it was double-Greek to me).
Barbara Morgan, Leeds

The answer to both your questions is a qualified yes: it does require quite an appreciation of digital electronics. If you are serious then I suggest that you start reading magazines such as *Electronics Today International* and *Practical Electronics*, both of which frequently have articles aimed at the beginner. They are also both becoming more 'micro' aware and patience will eventually pay as projects like exposure meters and timers are very much their stock-in-trade. However, you are more likely to find it cheaper and easier to buy one of the many kits for these particular two projects but which, unfortunately for you, don't use micros but a dedicated collection of bits and pieces.

If you are still game then try and join a local computer club where you are bound to find someone only too pleased to assist you in return for some help in programming. As far as your choice of micro goes, you might be better off choosing one of the tried and tested 'trusties' such as the Nascom or the UK101 which have been around longer and so there is a much wider 'base' of prospective sources of solutions to any given problem rather than with some of the newer ones.

There are several ways in which a computer can measure an analogue voltage, the easiest being to compare it with a rising sawtooth of known value — the length of time taken to reach equality being proportional to the input voltage. This time can be measured by the computer executing loops of known duration and checking for equality after every loop.

Reference voltages can either be a humble zener diode or for more sophisticated uses, a specialised reference voltage chip.

Exposure time can be measured again by using timing loops but this time looking at the duration of a square wave signal whose frequency is adjusted by a light-dependent resistor.
M Dennis

MICRO CHESS

by Kevin O'Connell

THE DEVIL STRIKES

The devil referred to in the heading is 'Mephisto' or Mephistopheles. Mephisto is a small stand-alone chess machine which happens to be the only one manufactured in Europe. It is fitting that it is made by a Munich firm, Hegener & Glaser, since computer chess generates more popular interest in West Germany than in any other country except perhaps Hong Kong or the USA. Running on the 1802, Mephisto has phenomenally long battery life but very little computer power compared with machines using the 6502 and Z80.

Mephisto was programmed principally by Thomas Nitsche of Munich. He and his team of programmers were also responsible for Parwell which performed so disappointingly in the World Computer Championship in Linz (see *PCW*, December 1980) despite running on an apparently powerful system comprising a Siemens SMS2 (128k RAM) and 128(!) 8080As each with 16k RAM — a grand total of 2 megabytes of RAM!

By comparison the commercial Mephisto machine seems puny, with just 1k RAM and 6k ROM, but its purchase price of £125, combined with its playing strength, ensured that it was a complete sell-out when it came on the German market last year.

Although Mephisto didn't win the Hamburg-Munich Computer Open last year, it did fare quite well, as you can see from Table 1.

The new experimental Mephisto (with 8k ROM) being prepared for the 1981 market was tremendously successful at the annual micro tournament in Stockholm last December, as can be seen from the scores in Table 2.

A three-round tournament is a very short event, but Mephisto was a very clear winner. Here is an interesting win by Mephisto against one of the programs which shared second place. The game is particularly interesting because both sides give up material for positional considerations.

White: Mephisto X (level 6)
Black: Mychess (Level 4)

1.	e2—e4	e7—e5
2.	Ng1—f3	Ng8—f6
3.	Nb1—c3	d7—d6
4.	d2—d4	e5xd4
5.	Nf3xd4	c7—c5
6.	Bf1—b5+	Bc8—d7
7.	Bd5xd7+	Qd8xd7
8.	Nd4—e2	Nb8—c6
9.	0—0 (Ke1—g1)	0—0—0 (Ke8—c8)
10.	Bc1—e3	g7—g6
11.	f2—f3	Bf8—g7
12.	Ne2—f4	Rh8—e8
13.	Nf4—d5	Nf6xd5
14.	Qd1xd5	

Both sides have completed their development and White has an edge, thanks to Black's weak and backward d-pawn.

14.	. . .	Nc6—d4
15.	Rf1—c1	Kc8—b8
16.	a2—a4	h7—h5
17.	Qd5—c4	

White needs to find a way to dislodge the knight from d4 so that decisive pressure can be built up along the d-file.

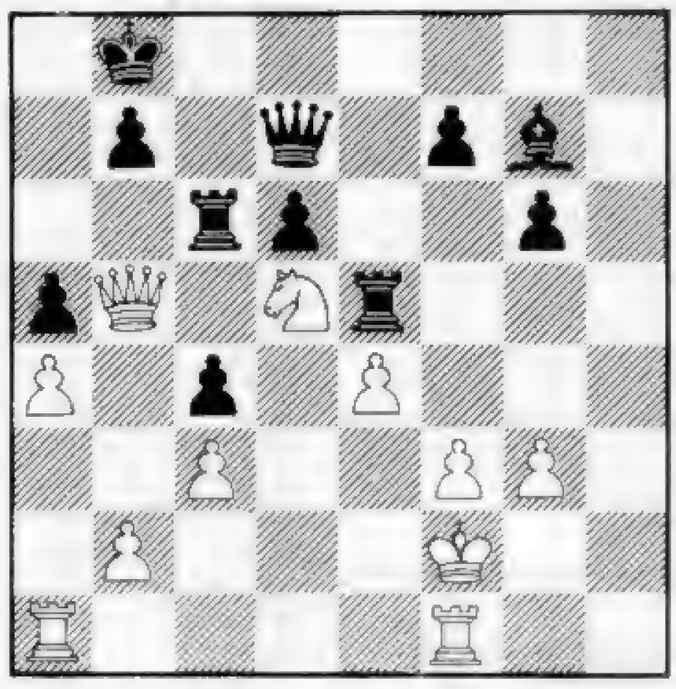
17.	. . .	a7—a5
18.	Be3—g5	

But now White should have continued the logical plan with Nd1 and c3, followed by putting his major pieces on the d-file as a prelude to winning the weak d-pawn.

18.	. . .	Rd8—c8
19.	Bg5—f4	Rc8—c6
20.	Nc3—d5	Nd4—e6
21.	c2—c3	Ne6xf4
22.	Nd5xf4	Bg7—h6
23.	g2—g3	h5—h4

Here, or on the next move, Black should really capture on f4 but Mychess seems to prefer bishops to knights.

24.	Rc1—f1	h4xg3
25.	h2xg3	Re8—e5
26.	Kg1—f2	Bh6—g7
27.	Qc4—b5	c5—c4
28.	Nf4—d5	



28.	. . .	Qd7—e8

A very surprising decision. There was nothing at all wrong with Qd8, defending the a-pawn. However, the text move does give Black considerable attacking chances against the white king.

29.	Qb5xa5	f7—f5
30.	Ra1—d1	

Now it is White's turn to give up material for positional considerations — if more computer programs could play like this there would be more very strong chess programs!

30.	. . .	f5xe4
31.	f3xe4	Re5xe4
32.	Kf2—g1	Rc6—c5
33.	Qa5—b6	Rc5—c6
34.	Qb6—b5	Qe8—e6
35.	Nd5—f4	Qe6—g4
36.	Nf4—g2	Rc6—c5?

A serious mistake.

37.	Qb5—b6	Bg7—e5
38.	Rd1xd6!	

If Black takes the rook then 39. Qxd6 + Ka7 (39. . . Kc8 40 Rf8+ forces mate) 40. Qxc5+ with a quick win.

38.	. . .	Rc5—c7
39.	Rf1—f8+	Rc7—c8
40.	Rf8xc8+	Qg4xc8
41.	Rd6—d8	g6—g5
42.	Rd8xc8+	

and White won easily. The game ended: 42. . .Kb8xc8 43. Qb6—f2 Kc8—b8 44. Qf2—f8+ Kb8—c7 45. Qf8—f3 Be5—d4+ 46. Kg1—h2 Re4—e7 47. c3xd4 Re7—h7+ 48. Kh2—g1 Rh7—d7 49. Qf3—c3 Kc7—b8 50. Qc3xc4 Rd7—d8 51. d4—d5 Rd8—d7 52. Qc4—e4 Rd7—d8 53. Qe4—e5+ Kb8—c8 54. Qe5xg5 Kc8—c7 55. Ng2—f4 Rd8—e8 56. Qg5—g7+ Kc7—b8 57. d5—d6 Re8—e1+ 58. Kg1—h2 Re1—c1 59. Qg7—d4 Rc1—c2+ 60. Kh2—h3 Rc2—c1 61. d6—d7 Rc1—h1+ 62. Kh3—g2 Rh1—h6 63. d7—d8Q mate.

New developments

Many new chess computers were unveiled at the Consumer Electronics Show in Las Vegas in January and at the Nuremburg Toy Fair early in February. Both hardware and software showed obvious signs of having made great strides over the past year and it is probably correct to say that the top machines in the range are of a completely new generation.

GOTO page 127

		1	2	3	4	5	6	7	8	9	10	11	12	13	
1	Boris MGS 2.5	xx	11	1½	1½	10	11	½1	11	11	11	11	11	1½	21
2	Boris ARB 2.5	00	xx	11	11	11	1½	11	11	½½	11	11	11	11	20½
3	Mephisto	½0	00	xx	11	½0	1½	½1	10	½0	11	11	11	11	15½
4	Challenger 7	½0	00	00	xx	10	½1	11	11	11	11	10	11	½1	15½
5	Chess Shampion Mk IV	10	00	1½	10	xx	00	10	10	11	01	11	½1	11	14
6	Challenger 8	00	½0	½0	0½	11	xx	1½	0½	10	11	01	11	11	13½
7	Chess Champion Mk III	0½	00	0½	00	10	½0	xx	10	11	1½	01	11	11	12
8	Challenger Voice	00	00	10	00	10	½1	10	xx	01	11	01	11	10	11½
9	Atari video	00	½½	1½	00	00	10	00	01	xx	½½	½½	01	11	9½
10	Challenger 10	00	00	00	00	01	00	½0	00	½½	xx	11	10	11	7½
11	Boris Diplomat	00	00	00	10	00	01	01	01	½½	00	xx	10	01	7
12	Pocket Chess	00	00	00	00	0½	00	00	00	01	10	10	xx	1½	5
13	Saba video	½0	00	00	0½	00	00	00	10	00	00	01	½0	xx	3½

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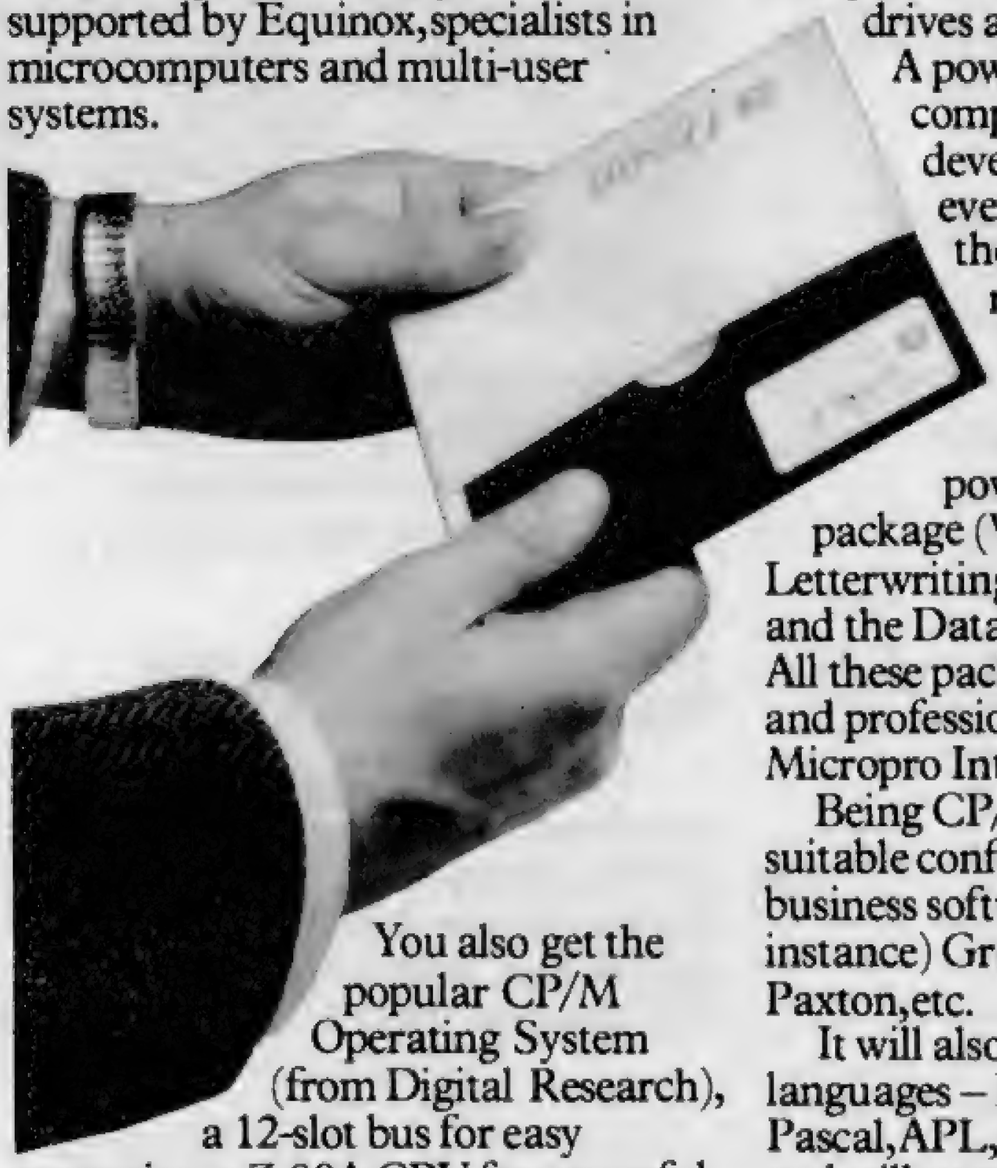

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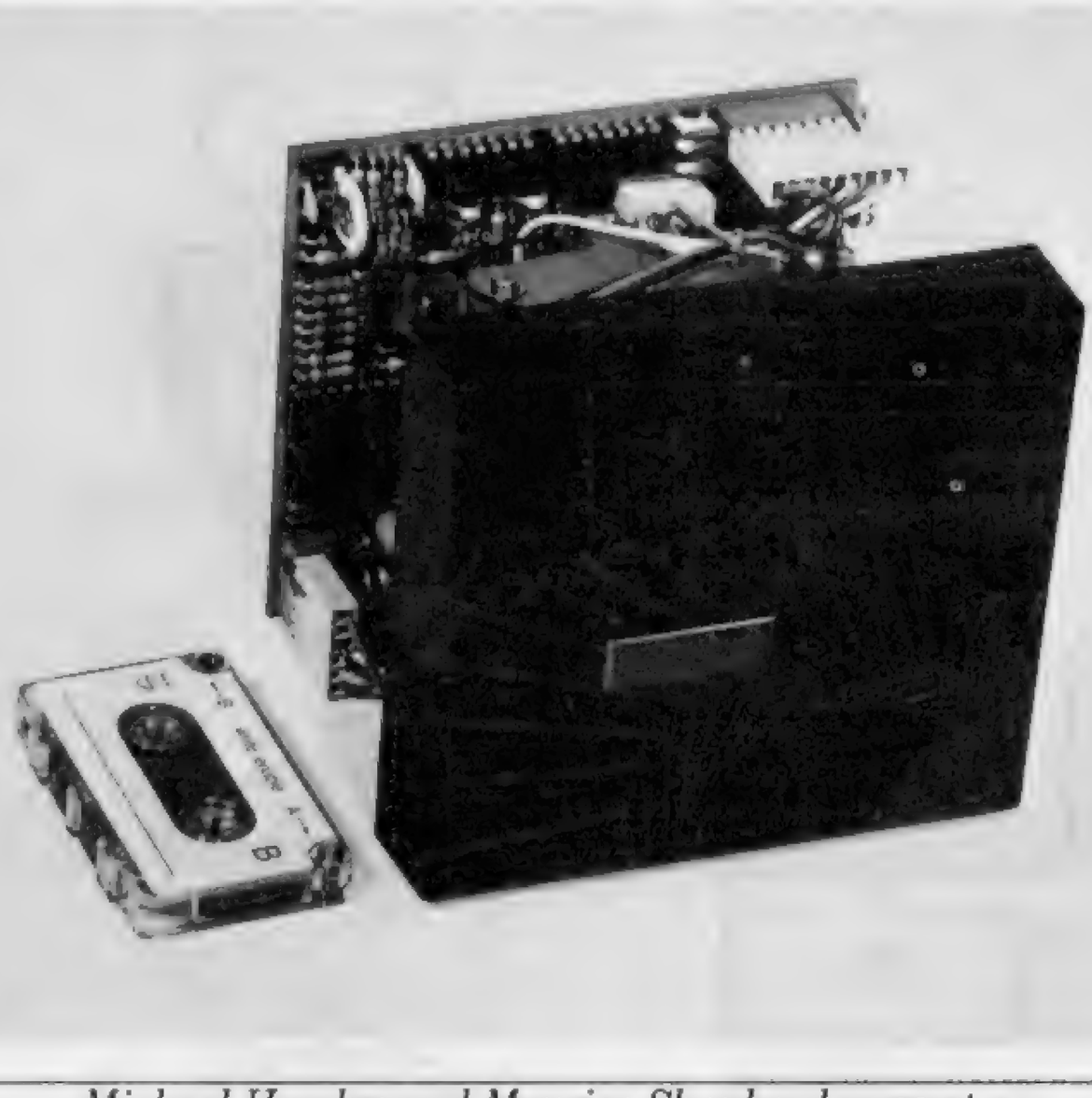

Michael Hendry and Maurice Shepherd suggest a low-cost but fast file storage and management system.

The two most commonly-used storage media for microcomputers are audio cassettes and floppy disks. Although audio cassette-based systems are inexpensive, they are neither convenient to use nor particularly reliable, especially with regard to the interchangeability of tapes recorded on different machines. Disk systems, on the other hand, offer high data transfer rates, greater reliability and a software or firmware disk operating system but they are expensive — a dual-drive mini-floppy is likely to cost at least £600. It was this large price difference that led us to consider the possibility of a tape-based system which, while retaining the reliability and file-handling advantages of disk storage, could be produced at a considerably lower cost.

The initial decision was to base this alternative system on digital recording, where the tape is always magnetically saturated in either polarity, rather than audio encoded recording, and to use a very reliable and proven digital recorder. The Philips mini digital cassette recorder (DCR), with a quoted irrecoverable error rate of 1 bit in 10^9 bits, met these requirements and is available at less than half the cost of most mini-floppy disk drives. Modification of a standard audio cassette drive was rejected as a useful approach. The development of a working system involved providing a hardware interface between the DCR and the micro bus and also writing software which would give the user facilities similar to those of a typical disk operating system.

The specific objective was to operate two of the Philips mini digital cassette recorders from a Nascom microcomputer. In this article we shall discuss the various design considerations in fairly general terms and give a more detailed description of the tape operating system devised for Nascom.

Pictured above: Fig 1 Philips mini digital recorder with cassette.

The Philips DCR

The Philips mini digital cassette recorder is a relatively small unit, fitting approximately into a 4in cube. Mechanically it is very much simpler than a floppy disk drive which suggests that it should have better overall reliability. It is a twin track machine which reads and writes phase-encoded data at 6000 Baud. The Philips digital mini-cassettes (Figure 1) contain approximately 115ft of 0.15in wide tape which is certified free from drop-outs; the tapes have a runtime of about 90 seconds and can store 64k 8-bit words on each track. Unlike conventional audio recorders, the tape is hub driven — there is no capstan — resulting in tape speeds of 10-18in per second depending on the distribution of tape between the two spools. This is equivalent to tape densities of 560-330 bits per inch. A single motor drives the tape in either forward or reverse directions and the tape direction can be reversed in less than 0.15 second. The entire unit, including the motor and the integral signal interface board, requires a +12 V power supply and has a nominal current consumption (motor running) of 120 ma.

The signal interface board, which is largely CMOS, is mounted at the back of the DCR and uses the nine status, data and control signals described in Table 1. The status signals $\overline{CIP}$ and $\overline{WEN}$ are derived from sensing microswitches in the DCR and the $\overline{BET}$ signal is activated by circuitry on the interface board which detects when the motor is stalled on reaching either end of the tape. Removal of either of the plastic write-enable plugs from the cassette automatically prevents data from being written to the relevant track of the tape as well as activating the status signal $\overline{WEN}$. All these signals use +12 V positive logic.

The $\overline{WDA}$ line requires phase-encoded data at a rate of 6000 Baud + 1 percent. This can be obtained by XORing normal data with a 6kHz data clock as shown in Figure 2. Phase encoding ensures that the tape magnetisation polarity is reversed at least once for each data bit. The output signal $\overline{RDA}$ can be read using the positive going edge of the internally-generated $\overline{RDC}$ signal as a strobe. It is essential with phase-encoded data that the read clock is properly synchronised in that it only stobes after valid transitions, ie the arrowed transitions in Figure 2. This is achieved by prefacing the 'real' data with a repetitive 1010 binary sequence known as the preamble, such as the hexadecimal character A, and which is subsequently responsible for synchronising the read electronics. Blocks of data are written onto the tape with the general format shown in Figure 3; the cyclic redundancy code characters are generated externally. Data can be written synchronously, ie, without the start and stop bits obligatory in asynchronous serial transmission, with a consequent improvement in storage density and byte transmission rate. A transmission rate of 6000 Baud of synchronous data is equivalent to 7500 Baud of asynchronous data using one start and one stop bit. Tape transport is controlled by the $\overline{FWD}$ and $\overline{REV}$ lines. $\overline{WCD}$ gates data onto the $\overline{WDA}$ line and if data is not sent the tape is erased. There are a number of timing requirements regarding the control signals which must be met and which are given in detail in the DCR manual. These allow, for example, for the finite start, stop and reverse times of the tape transport.

The micro DCR interface

One may now look at some of the practical aspects of designing an interface to operate between the DCR signal interface and a microcomputer bus. The necessary functions include (a) address decoding, (b) latching DCR control signals from the data bus, (c) tri-state buffering of DCR status signals onto the data bus, (d) phase-encoding serial data, (e) generation of a 6 kHz clock signal and (f) voltage translation between the micro TTL logic levels and the 12 V logic of the signal interface board. These can all be done using relatively simple TTL and/or CMOS. A rather more complicated chip is required for the necessary parallel to synchronous serial conversions. Since our particular application involved a Z80 bus the obvious choice was the Z80 SIO (Serial input/output) chip but there are several other chips available which could be used such as, for example, the Motorola MC6852 series.

The Z80 SIO chips and their Mostek equivalents have, until recently, been rather difficult to find in the UK. They have also been quite expensive but the manufacturers' prices have now dropped considerably. The SIO, which is available in several versions with different bonding options, is a programmable dual channel device which can handle most synchronous serial protocols as well as asynchronous serial-parallel conversion. In the synchronous modes it can generate and check cyclic redundancy codes (CRC) and provide the necessary character synchronisation. It also has the Z80 vectored interrupt facilities. Being a programmable device, like the more familiar Z80 PIO, its versatility depends on appropriate software. The SIO allows the programmer access to three read and seven write registers and the device manual extends to almost 30 pages. A brief summary of the programming methods will not be attempted.

One further requirement of the interface is that interblock gaps can be detected. This is necessary in order to be able to rewind the tape to the beginning of a specified block. One means of doing this is to monitor the output of a retriggerable monostable with the input signal being the RDA line.

A schematic diagram of a micro-DCR interface, showing the main interconnections, is given in Figure 4. For the sake of simplicity, this diagram only shows one set of DCR control signals although a single SIO, being a dual channel device, can support two DCRs. With a Z80 system, the buffer, the latch and the SIO can be conveniently addressed through the I/O ports — on other micros direct memory addressing may be necessary. An alternative approach is to use a special purpose cassette controller chip. In our experience this did not have a sufficiently marked effect on the overall chip count to compensate for the loss of the very versatile Z80 SIO.

The prototype wire-wrapped Nascom interface board and the two associated digital recorders are shown in Figure 5. This particular board also includes the 2k tape operating system (TOS) in two 2708 EPROMs and the TOS workspace in two 4118 static memory chips. These

		Description.*
STATUS SIGNALS		
	$\overline{CIP}$	Cassette in position.
	$\overline{BET}$	Beginning or end of tape detected.
	$\overline{WEN}$	Write-enable plug in position.
DATA SIGNALS.		
	$\overline{WDA}$	Input channel or write amplifier.
	$\overline{RDC}$	Internally generated read data strobe.
	$\overline{RDA}$	Output channel of read amplifier.
CONTROL SIGNALS.		
	$\overline{RWD}$	Tape driven in forward direction.
	$\overline{REV}$	Tape driven in reverse direction.
	$\overline{WCD}$	Information gated to WDA line.

* Descriptions of status and control signals refer to the active low condition.

Table 1 The DCR interface signals.

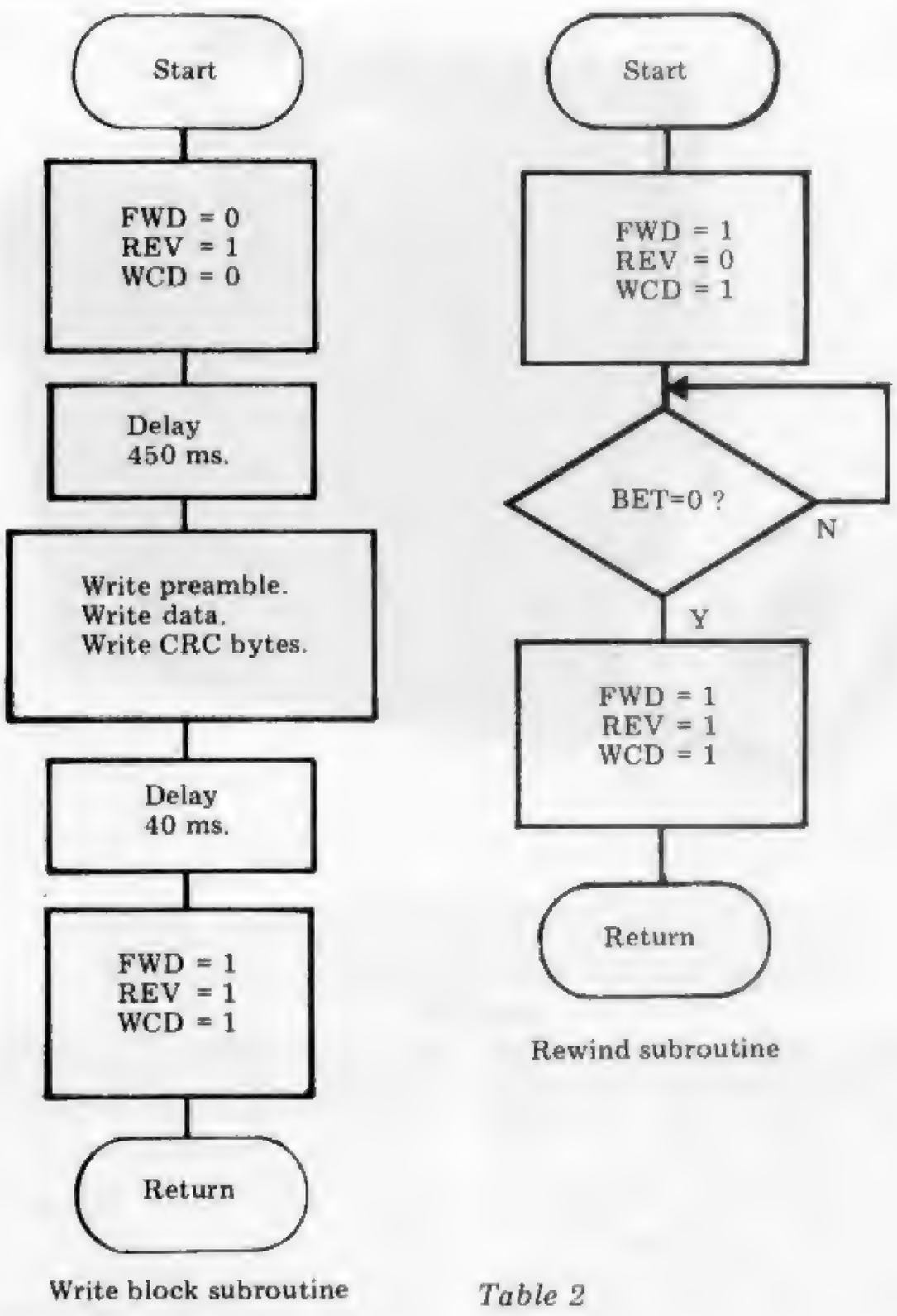

Table 2

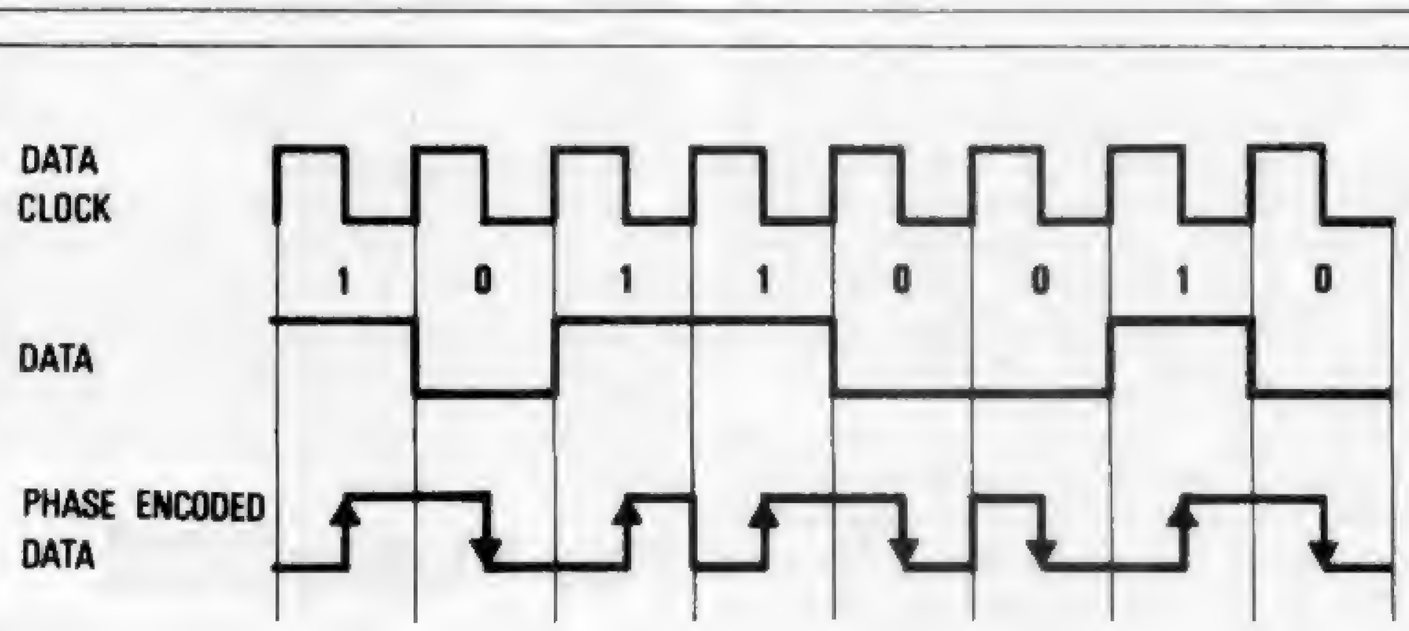

Fig 2

chips can alternatively be located on the Nascom 2 CPU board.

Software

The software for the interface described above must include a set of routines which will, for example, read and write blocks of data, backspace and tape through a block of data, rewind the tape and provide error checking. These routines involve (a) programming the SIO (or equivalent device) and/or (b) handling the DCR interface signals, within the constraints imposed by the various timing requirements of the DCR.

The simplified flow charts in Table 2 illustrate a write block subroutine and a tape rewind subroutine. The write block example also requires SIO programming to deal with the preamble, the data and the CRC generation. Software loops can give the necessary delays.

These various routines may then be amalgamated into an overall tape operating system (TOS) which permits specific files to be written, read or deleted.

TOS

The actual set of commands devised for the Nascom TOS are given in Table 3. These are all single character commands, similar to the Nascom monitor commands, with up to three obligatory arguments. TOS supports two DCRs but runs with only one DCR present although the transfer command (T) is obviously inoperable under these circumstances. The TOS software occupies 2 kbytes and was located at D000 in the prototype.

TOS makes extensive use of NAS-SYS monitor routines and automatically detects whether the NAS-SYS 1 or the NAS-SYS 3 monitor is being used; it will also operate with either a 2 MHz (making it compatible with Nascom 1 using NAS-SYS) or a 4 MHz system clock.

The operation of TOS can best be explained after examining the format of a TOS written tape track (Figure 6). The directory and the data blocks are all 2 kbytes long. The directory contains all the necessary information on the status of that particular track, ie, a tape track identification number and the filenames and filetypes of all files stored on the track and the specific data blocks that these files occupy. A file of less than 2k occupies an entire padded-out 2k block; similarly an 8.5k file, for example, requires five data blocks. A single tape track has a storage capacity of 56 kbytes, excluding the directory.

On entering TOS (for example by E D000) the tapes in both DCRs are rewound and both directories are read into RAM directory workspace. After all write or delete commands the relevant RAM directory is updated and then rewritten into the appropriate tape directory block.

Following a write command (B, P or W) TOS requests, through screen prompts, a filename (up to 17 characters) and, in the case of a W command, a filetype (1 character). These are used solely for identification purposes in the catalog display — files are always accessed by the number assigned to them by TOS and displayed in the catalog. This avoids the tedious and error prone procedure of typing in filenames used in most disk systems. The file is then written into the first available free blocks on the tape. After each block is written the tape is backspaced and the block is read and the CRC checked, giving automatic verification. If an error is detected, the block write/read cycle is repeated and if an error persists after the second attempt then an error message is displayed and the

GOTO page 147

ARGUMENTS:- (obligatory argument)

DCR	: : =	{A / B}
filenumber	: : =	two digit decimal number
start	: : =	four digit hexadecimal number
end	: : =	four digit hexadecimal number

COMMANDS:-

B DCR
Saves the current BASIC program on the specified drive.

C DCR
Displays the catalog of the specified drive.

D DCR (file number)
Deletes the specified file from the specified drive.

I Initialises a 'blank' tape in drive A.

J Cold start to Basic.

N Jump to NAS-SYS monitor.

P DCR
Save the current NASPEN file on the specified drive.

Q Warm start to NASPEN text editor.

R Rewinds both tapes and reads the catalogs of both tapes

R DCR (filenumber)
Loads the specified file from the specified drive into the machine memory.

T DCR (filenumber)
Transfers the specified file to the other drive.

W DCR (start) (end+1)
Writes binary code from location start to location end as a new file to the specified drive.

X Rewinds the tapes in both drives. (cf. R)
Tapes may then be safely removed.

Z Warm start to Basic.

Table 3 Nascom TOS command table

Fig 3

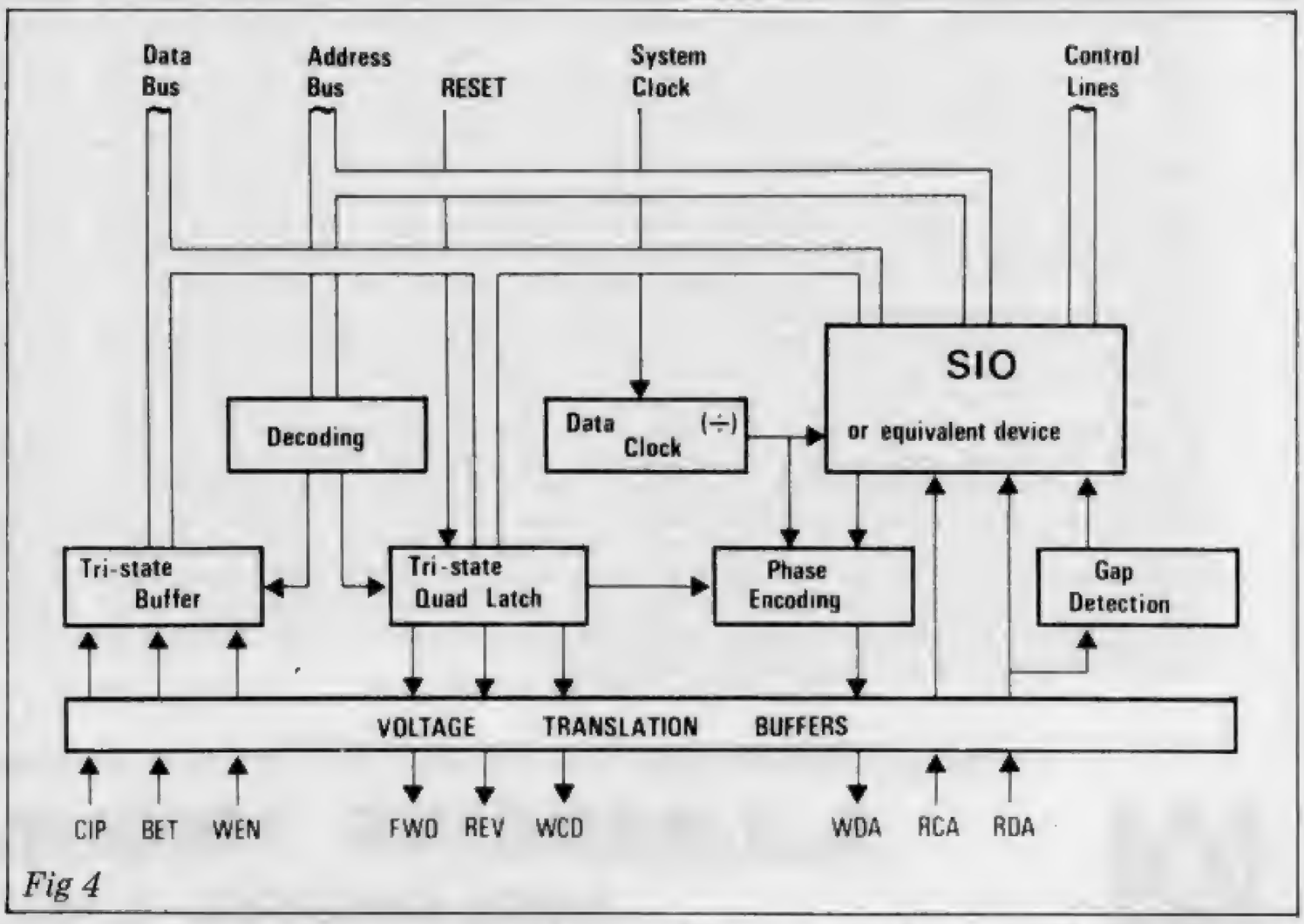

Fig 4

CALCULATOR CORNER

Compiled by Dick Pountain

THE TEXAS TICKLED

Several months ago, a reader and professional TI59 user, Mr Weaver, sent me an article from the German magazine Chip. *In this article, the author reported the discovery of a method of doubling the execution speed of TI59 programs, which, as any patient user will know, is a very worthwhile improvement.*

Unfortunately, the original article contained errors and was written in a rather obscure fashion, as a result of which Mr Weaver could not make it work. My own attempts to decipher the piece were no more successful, but before giving up hope I sent the piece to Norman Horwood, who has previously written on TI affairs for this column (see PCW *3-1, 3-5).*

Mr Horwood's expertise in TI59 programming finally triumphed but only after hours of frustration and the lucky discovery of a vital clue which is omitted from the original piece!

Here is Mr Horwood's account of the method by which programs, written under certain special rules, will run at double speed on the TI58/59 calculations.

The trick depends on fooling the operating system into thinking it is running a module program, when, in fact, it is running your own program. As a result, the processor no longer interrogates the keyboard for user interrupts (eg, R/S, Pause, Trace) between every step executed, as is the case during normal execution.

This results in a 100 percent saving in processing time. The rules for writing programs in this Fast Mode are, however, very strict and rather limit possible program structures.
Dick Pountain

I shall demonstrate the technique by reference to two short programs. One I have published before in *PCW* (May 1980) called 'Auto-Folio' which demonstrates the main modifications required to allow the new system to work, and another, extracted from the *Chip* article and edited and modified to make it work at all, to demonstrate the speed advantage.

The system depends on entering the library module at an address where there is a merged code '31'. This is the Op Code for LRN. (Learn mode, used from the keyboard to enter program instructions). It must have taken our EEC friend many hours of bending over library downloads to find this serendipitous coding, even if he/she knew what he/she was doing. Incidentally, it only seems to work with the Master Library Module (ML 1), at least I have been unable to obtain the fast mode with the Maths Utility Module, even having found a 31 coding in programs 6 and 7 at locations 108 and 454 respectively. The initialising procedure seems to be working but the speed is unchanged.

Apparently, with the ML 1 in place, the pseudo call via an indirect SBR op to the 31 code location, 250, in program number 2 makes the processor think it is in the module when actually processing an external user program. This has the characteristic of ignoring the keyboard during processing, just as when the program enters the module, so that after every operation the pointer no longer tests the R/S, Pause, Trace as in normal processing. This is where the time is saved. It does mean that special steps have to be taken to allow data to be entered during a run, since when a stop instruction is encountered in one of these special programs, leaving data displayed, the attempted addition of different figures merely adds to the displayed figures in decimal form; ie, with the display showing 123, keying in 456 alters the display to 123.456 and not 456, as if an operation had not been completed in the program.

The method of gaining access to the fast mode is via the following key strokes: 000 start point — 2,4,0,STO 00, 2nd, Pgm, 02, SBR, 2nd, Ind 00, EE, INV, EE, R/S. This occupies 14 program steps and is entered in normal learn mode, exiting in the normal manner, LRN. With this program in memory press RST, R/S. The display blanks for a fraction of a second then displays zero. The machine is now in fast mode, and almost anything will either crash or destroy the new mode, reverting to standard. A total reset has taken place and any contents of memory, data or program instructions has been cleared. It is possible to enter the learn mode, but the display has no obvious relevance (1803 52) except that the 52 is the code for 'EE'. Single stepping in this condition produces an incremental increase to the four figure number with the Op Code following the listing INV, EE, R/S. to step No. 1806, any further stepping leaving the learn mode for ever; nothing can be done to feed another program by any method. The Reset key is the only active key, and this reverts the system to standard.

Any operational program now must be read into memory through the card reader. If there has to be a change of partitioning as in the 'Auto Folio' example, this must be part of the initialising process contained in the magnetic card listing. After reading the program card/s, each bank number will be displayed as normal, and it is possible to employ protected cards. From the listings reproduced it can be seen that both the Fast Mode and the Operational programs start at 000. This is for convenience, but it should be remembered that the Fast Mode (FM) program must end with a legal R/S (ie, preceded by either CLR or EE, INV, EE) or the processing will start immediately a card has been read and continue unstoppable until a legal R/S is encountered in the program. Once the required program is safely in memory it is possible to start processing at any location by calling a subroutine and a three digit address. Indirect addressing is allowed, but the register must be pre-loaded with the address location when the cards are loaded into memory. It is *not* possible to manipulate memory data in Fast Mode from the keyboard.

In our examples both programs are started by SBR 000. It is now possible to edit the program by entering Learn without affecting the Fast processing, but if you list the coding and allow the printing to go beyond the program length, this will exit from FM. However, if the listing is stopped by pressing R/S before reaching the end of your program, processing starts at that point and the pointer ends up where the remnant of the program takes it. The system remains in FM as long as the pointer remains in play.

As TI 58/59 users will be aware, in order to produce hard copy of data input, especially where large volumes of results have to be accumulated and analysed from random records, one is forced to use the Trace mode with the printer. This is fine for simple arithmetical entries where each data entry is accompanied on the same line by the operation following (+ — x +). However, when data has to be accumulated into analysed registers the Trace system prints each data value twice and the data register separately, taking three lines for each entry. Auto-Folio prints the data value and the register number together on the same line, and simultaneously sums the amount into that register, so that at the end of a session INV 2nd List produces a full analysis of the data. The partitioning used in the example makes 99 registers available.

The procedure is simple. With the original, standard speed version the value is entered with + or — (+/— key) and 'A' pressed — the display clears — then the desired analysis register number is keyed in (1 to 99) and R/S pressed. After about four seconds the value entered and the data register number are printed on one line. In Fast Mode, the keys A,B,C,D,E, are no longer available so the program has been looped at step 061 to return the pointer to the start position. This allows the R/S key to be used for both entries. The new procedure is therefore — enter the value — press R/S — the display clears — enter the register number as before and press R/S. This time it only takes two seconds for the printout to complete.

I will not dwell on the HIR Op codes here as this aspect has been fully covered before, except to note that while the FM initiation program clears everything out of memory, it leaves the pending operation stack (HIR) and the T register alone.

CALCULATOR CORNER

The conversion from normal subroutine calls which are no longer legal has been obtained in this case at steps 027 to 034 combined with 072 to 075, and 039 to 046 combined with 076 to 079. Here, the GTO instruction has been combined with flag setting, testing and unsetting. This gives reasonable flexibility with safety, and I think, is better than GTO with variable indirect addressing, as long as there is enough program space and you don't run out of flags. I am wary of introducing non-data numerical instructions in the middle of computation, as this usually means that the computed data must be saved somewhere and brought back safely — very risky.

The second example is lifted straight from the *Chip* article, duly edited to make it work. This is a simple iterative loop which calculates factorials, and is a neat method for comparing processing times. The procedure is to load the FM program, run it by RST, R/S, and load the Factorial program card, initialising by pressing SBR 000. To obtain the factorial of any number up to the maximum for the machine (69), enter the number and press R/S. All the calculation is done in the loop 006 to 012, the rest of the instructions format the printout. In normal mode the time for the calculation of 69 is approximately 29 seconds; in Fast Mode the time is literally halved to 14.5 seconds. The only alteration from standard required for this program to operate in FM is the CLR,R/S section at 000. Alternatively, EE, INV, EE,R/S could have been used to leave the result in the display as well as print it. If you change this, don't forget to change the loop address to DSZ, 00, 00, 08. to allow for the two extra instructions. Do not be tempted to use RST instead of GTO, 00, 00. at the end as this will make the system revert to normal after the first run.

Summarising the special rules for using the Fast Mode: almost any key will start processing; calculations cannot be carried out on the keyboard; CLR, CE, EE, INV EE work; RST and CP keys cause exit from FM; RST in a program also causes exit from FM; no SBRs can be called in a program; no Module programs can be called; no functions using firmware (P/R, DMS, E+, etc) can be used; no labels; flag 8 error detection not available; RTN will not work; always start a new program with SBR nnn or SBR Ind NN; always precede R/S in a program with either CLR or EE INV EE or with a pending calculation where the entry of a digit from the keyboard will add to the display and not replace it (with the last method, in order to be able to enter a new value, it is necessary to press CLR or CE first to remove the displayed figure if necessary); all program cards must be recorded in 'Power-up' partition as the FM program re-sets to this.

All in all this fast mode looks as though it can be quite useful, certainly where long loopy routines are required. The preparation of tabulated results with significant amounts of printing will be attractive applications as the speed of printing is also greatly increased, but beware of overcooking the printhead as I have during the experimentation on this method. I am certain that there are more tricks and short cuts yet to be discovered, and I hope *PCW* will find space to print them when someone finds them. Finally, would some bright person please tell me why this works?

N Horwood

Initialise fast mode

```
000   02   2
001   04   4
002   00   0
003   42 STO
004   00   00
005   36 PGM
006   02   02
007   71 SBR
008   40 IND
009   00   00
010   25 CLR
011   91 R/S
```

Auto-folio

```
000   01   1
001   00   0
002   69 DP
003   17   17
004   25 CLR
005   91 R/S
006   82 HIR
007   03   03
008   07   7
009   32 X:T
010   25 CLR
011   91 R/S
012   42 STO
013   00   00
014   55   ÷
015   01   1
016   00   0
017   54   )
018   75   -
019   59 INT
020   82 HIR
021   04   04
022   54   )
023   65   ×
024   01   1
025   00   0
026   54   )
027   86 STF
028   01   01
029   61 GTO
030   00   00
031   64   64
032   22 INV
033   86 STF
034   01   01
035   85   +
036   53   (
037   82 HIR
038   14   14
039   86 STF
040   02   02
041   61 GTO
042   00   00
043   64   64
044   22 INV
045   86 STF
046   02   02
047   54   )
048   65   ×
049   01   1
050   00   0
051   00   0
052   95   =
053   69 DP
054   04   04
055   82 HIR
056   13   13
057   74 SM*
058   00   00
059   69 DP
060   06   06
061   61 GTO
062   00   00
063   04   04
064   22 INV
065   77   GE
066   00   00
067   70   70
068   85   +
069   02   2
070   85   +
071   01   1
072   87 IFF
073   01   01
074   00   00
075   32   32
076   87 IFF
077   02   02
078   00   00
079   44   44
```

Factorial

```
000   25 CLR
001   91 R/S
002   42 STO
003   00   00
004   42 STO
005   01   01
006   43 RCL
007   00   00
008   65   ×
009   97 DSZ
010   00   00
011   00   00
012   06   06
013   42 STO
014   00   00
015   07   7
016   03   3
017   00   0
018   00   0
019   00   0
020   00   0
021   00   0
022   00   0
023   69 DP
024   04   04
025   43 RCL
026   01   01
027   69 DP
028   06   06
029   43 RCL
030   00   00
031   99 PRT
032   61 GTO
033   00   00
034   00   00
```

SECRETS OF SYSTEMS ANALYSIS

PART 9: FINDING AND SUPERVISING A PROGRAMMER

This month Lyn Antill examines the various methods of finding and choosing programmers.

The series has now reached the point where you have analysed your requirements, designed a system to meet them, chosen a machine and specified the programs that are going to run on it.

In previous articles I've blithely referred to 'your programmer' and maybe you do, in fact, have one. Some users have friends who are programmers, others will be working in firms which have their own data processing department writing programs for user departments. However, for many users and potential users of micros, programmers are alien. They don't know how to find one, how to recognise a good one, what to pay them, how quickly they should be able to work, how to tell whether they're doing a good job, or how to make them come back and fix the bugs you found after they went.

Of course, there's a man-management side to this which is quite outside the scope of this series and you'll have to use your own judgement in such matters. But programmers aren't as easy to come by as plumbers, nor do they necessarily have recognisable qualifications and a regulating body like accountants or lawyers. So it's more difficult to recruit someone to come and do some programming for you.

Types of contract

There are several ways of hiring a programmer. You could employ one, or you could get one of your staff to go on a programming course. Alternatively you could buy in the services of a software house or a freelance programmer, either by the day or on a fixed price for the job. Each of these has its merits and drawbacks. The solution you choose will depend on a variety of factors: how quickly you want the job done, how long it is likely to last, how much you're willing to spend and what staff are available. I'll discuss each of these possibilities in turn.

Hiring a programmer

This makes the man-management side of things so much easier. The guy's on your payroll, in your office from 9—5, so you can see what he's doing and he can see what you're doing. I don't know which of these is more important but together they mean that he is part of a team. You can discuss problems as and when they arise and he can get a feel for the way your work is done.

There shouldn't be too much difficulty recruiting a programmer. You probably don't need anyone with a vast amount of experience and could probably do with a recent school or college leaver provided you can allow them time to become familiar with the machine. Quite a few schools and colleges now have micros so you could well find someone who knows how to program even if they were clueless about the applications side of it. Suitable qualifications are A-level Computer Science and the roughly equivalent, if more practical, City and Guilds 747. O-level and CSE Computer courses don't mean a lot on their own. City and Guild 746 is a part-time course covering only computer programming. An HND in Computer *Studies* should provide an ideal grounding for going into the world of commercial programming. Computer *Science* qualifications at HND or BSc level could indicate someone who was more interested in theoretical possibilities than in applications programs. You'll need to quiz them on what they've studied or, better, on what they've understood and appreciated about the importance of creating crash-proof, easy-to-use programs which conform exactly to the user's requirements. If at all possible, you want to find someone who's already familiar with the make of machine and the language you want him to use — if not, it could take him several weeks to get used to it and even more to become really fluent.

There are two ways of hiring — either as a permanent employee or on a fixed term contract. It's only worth doing the former if you're likely to have a regular supply of work, eg, if you want to computerise your whole operation a piece at a time it could well take a year or more, by which time you'll need to change and update bits of it. There is such a high turnover in junior programming staff that no-one is likely to want to stay more than a couple of years anyway. For a one-off job you may want to put someone on a six-month contract but be careful to put the length of the contract in writing before he starts or you may be in trouble with the employment legislation. You can't just kick someone out if he's been with you for more than six months unless you can prove he knew it was only a temporary job. Of course, this applies to any employee.

The sort of salary you could expect to pay for anyone with a qualification or training would be about £5-6000, although many young would-be programmers would be willing to work for less on a project that really interested them or that gave them an entry into the profession. Look at the job ads in the computer press to get an idea of what rates are current in your area. It's more expensive in the short term to hire a contract programmer: 1980 prices in London were in the order of £350 a week! (Mind you, that was for three years' plus experience, a good track record and long hours meeting short deadlines, so you could expect to get your program written much faster than by a junior.)

The one thing you cannot get from a contract programmer or from an employee is a guarantee that he won't get sick or have an accident. You don't have to pay an absent contract programmer but you will have to wait until he gets back or start again with someone else. Except where two programmers have been accustomed to working together and doing things in the same sort of way, it is next to impossible for one programmer to pick up where another guy left off.

Calling in a software house

This problem of a contract programmer going sick and leaving you stranded is one reason why you might choose to pay even more for the services of a software house. They will offer you some sort of guarantee of continuity. Quite how much continuity depends on the size and competence of the company, the small print in your contract and a bit of luck. Going to a software house doesn't guarantee you better service but it probably helps. However, if you're a small guy yourself you may feel outgunned by a large concern and feel that they are going to regard your needs as rather insignificant. There are plenty of small software companies — just a few friends working together — who have a far greater vested interest in providing you with a good service (and getting paid promptly).

A freelance programmer comes in to this sort of category, differing from a contract programmer in that he will quote you a price for a job and will not necessarily work on it in your office. They advertise in all sorts of places — your supplier will probably have a list of them. Provided you check up on their references and look at work they have done for other people, you should be able to pick someone who is reasonably competent.

SECRETS OF SYSTEMS ANALYSIS

PART 9: FINDING AND SUPERVISING A PROGRAMMER

How good a programmer?

To assess how competent someone is to do a particular job, you need to start by thinking about the job you're asking him to do.

The first thing is that he's got to understand what you want done; if you don't think you're getting through to him, maybe he's not the man for the job. A college leaver has probably been encouraged to believe that the important thing in programming is to crack the intellectual problem that the job poses. This is not because teachers don't realise that you have to get the details right but, because there is only a limited time for a classroom exercise, they know that if you can get the principles right then you can build on them later. Unfortunately, it sometimes takes the students quite a while to realise just how much building has to be done to get all the details right. A guy like that may well believe he understands all that you are trying to say just because he understands the gist of it: a teacher might not knock off many points in a programming exercise if the student sets a credit limit of £5000 instead of £500 because it doesn't affect the logic of the program but it wouldn't do your business much good! If you're not sure whether someone has understood, and grasped all the implications of what you're saying, then get him to tell it all back to you and ask him questions about it that would make him think about it in a different way. If you can find someone who has done a similar job before and can discuss it sensibly with you, then this is obviously a strong point in his favour.

The second thing a programmer has to do is analyse the logic of the program. This is the aspect on which many programming teachers concentrate. The details of the application, the language and the machine will vary from one job to another but the underlying logic will remain much the same. So, how do you assess, when you're interviewing someone, whether or not they can manage the logic? Many big companies use computer aptitude tests, which look similar to IQ tests. Obviously they can pick out the extremes of intelligence or obtuseness but apart from that I don't have much faith in them unless they are taken very seriously by both tester and tested and unless they are backed up by other specialised sorts of tests so that you can build up a profile of the candidate's ability in all sorts of situations. A colleague of mine has tried out an aptitude test on several generations of HND students. Their scores were mostly in the moderate to good range, but high scores on the tests didn't mean good exam grades. There are so many other factors that count for almost as much: willingness, persistence, etc.

Perhaps the simplest way to get a feeling for someone's logical ability is to see how quickly he grasps the essential elements of the work you want him to do, or the ease with which he can explain to you the essence of the work he's been doing. If you ask him to explain the bare bones of something, can he do so or does he get bogged down in the details?

The final thing that the programmer has to do is cope with the technical details of the language and the machine. Since you may not have your machine up and working, or the guy you're interviewing may not have used that particular machine before, this is rather difficult to test. Again, track record is the best guide — has he worked successfully on a similar machine in the same language? Just because someone has been successful on a different machine doesn't mean he'll be successful on yours. Working for a long time on one machine/language combination can mean you're set in your ways and slow to realise where a different approach is called for.

Some programmers are essentially interested in the insides of the machine and will be able to sort out technical bugs and make adaptations to the hardware or operating system. These people tend to be less interested in your application, if only because life is too short for everything. How much tinkering you will want your programmer to do will depend in part on how much you think you can trust your supplier. If you're dealing with someone who obviously runs a good workshop and is likely to be able to look after the machines he's supplied you with, and is willing and able to give technical advice, then you may well prefer to go for the applications-oriented programmer.

Timescales

Computer systems are notorious for getting behind schedule and many DP managers and textbook writers have their own favourite ideas about how to keep a project on time. They all boil down to two main points: spend plenty of time at the planning stage making sure that the programmer knows what you want and ensure that you know what he needs from you in the way of regular progress meetings, time for discussing problems, and practical support like samples of data for testing.

If the work is urgent, a good contract programmer (ie, one who knows how to do your sort of work on your sort of machine) can save you a fortune. One programmer I know charges his clients £25 an hour and saves them several hundred pounds per program because he has already written most of the routines needed to do their sort of work — and a new program is simply a new arrangement of these routines, which he can put together extremely simply and with very good prospects of it working first time. Anybody who hadn't already done this groundwork would take much longer to write the program and there would be a greater likelihood of serious errors being found when the program was tested.

For this reason it is very difficult to predict just how long it is going to take to get a computer program working. It's tempting to make what looks like a reasonable estimate and then turn it into an absolute deadline and gear your expectations and your other arrangements to having the system up and ready on that day. It is also tempting to set a deadline related to your business — getting an accounts system up by the beginning of the tax year, for example. It is psychologically difficult to deal with a single deadline several weeks or months away; you always feel that the petty delays and difficulties encountered at the start will be sorted out in time for 'the great push' to meet the deadline. There is also a large margin of error in setting that deadline in the first place. Programming projects are notoriously difficult to supervise because your programmer will spend at least as much time dealing with that 'one last bug' as he did creating the rest of the work. This is because he is creating program code which is not usually comprehensible to his supervisor; it can be quite difficult for one programmer to read someone else's program.

Even if the programmer is able to give you a reasonable estimate of the time and even if you add a bit to compensate for his optimisim, this is still likely to be the actual working time rather than the elapsed time and will presuppose that the machine is already working correctly and that the manual for it is both complete and accurate (and well indexed), and that you'll be available to answer questions at any time when the programmer is unsure about your requirements or wants to get your approval for a piece of work he has completed. Also, it assumes he won't be wasting time doing the wrong thing because he didn't understand what you wanted and you hadn't spotted whether or not he'd got the right idea.

Even if there are no major delays, it is quite staggering just how much time can be eaten up in small delays. For a start, the eight-hour day doesn't yield eight hours work. Psychologists reckon that you can't do more than six-hours' real work in an average day. This is simply because we have to attend not only to our physical needs (eating, etc) but also to our psychological needs. We really do *need* to talk to our colleagues if we are to work with them.

There are two other major causes of delay. The obvious ones are technical — either the machine is late or it's faulty or some of the 'extras' have to be ordered separately. (It's surprising how essential some of those extras seem to be, if only because we all have different ideas about what's essential.) These problems might be partly due to a user who hadn't checked out his supplier properly or who hadn't spelled out his

SECRETS OF SYSTEMS ANALYSIS

PART 9: FINDING AND SUPERVISING A PROGRAMMER

requirements in sufficient detail. It's not uncommon for software and hardware manuals to be hastily put together with typographical errors or poor indexes so that the programmer has to struggle a bit to make sense of them. These problems may be irritating or even disastrous but at least they are immediately visible.

The more insidious form of delay doesn't usually show until the program is nearly finished and you suddenly realise it isn't doing what you wanted it to. Even worse than this is the program that does do what you specified but when put into operation doesn't actually solve the problems that caused you to bring in the computer in the first place. This sort of delay can only be tackled by doing a good job of analysis and then putting in much more time with the programmer before he starts coding so he can understand just what you want and how you work and so that you can take a good look at him to make sure he really has grasped what is required.

Just to give a ball-park figure of the working time needed to get a program up, assuming that the machine is working and the programmer is familiar with both the machine and the problem, here are three typical applications and their development times.

1. Simple calculations: a program to accept data into a table, display it and manipulate it but without any fancy graphics or file handling — one week.
2. Simple file handling: accepting transactions, vetting them and using them to update a single master file and also permitting interrogation of the file and error detection and correction — one month.
3. Small program suite, or large program with a menu of several routines, with either graphics or else multiple file-handling — three months.

Programming is a classic example of the rule of increasing complexity. Small increases in complexity lead to large increases in the time taken.

Structured walkthrough

This is currently a very popular technique for managing the work of programmers. It provides a convenient way of breaking down the work into manageable parts. Each part is allocated a week or two for completion (less for a simple job) and is then tested before the next stage is begun. This means that you always know roughly how well you are keeping up with the schedule. Nothing can guarantee that you will meet your deadline but at least you will get some warning if you are going to be delayed. A simple version of the method suitable for a micro application would be this:

Session 1— Give the programmer the specification of what he is to do. Write down as much of this as possible and give additional verbal explanations. Give him permission to look around at the work being done as this helps him to understand what is required. Let him go away and digest this information.

Session 2 — Get him to explain how he sees the problem and how he proposes to go about solving it. Answer any questions. Repeat this session until you are sure the project is going in the right direction.

Session 3 — The programmer should tell you how the work has been broken down into parts so that you can set up a rough schedule for program design, coding, testing and implementing. For anything other than a small program, this break-down will have to be carried on at a lower level — program design will be split between the design of the various modules.

Session 4 — Look at the first part of the work in detail and decide on tight deadlines but leave the final deadline rather hazy. Repeat this process for each of the parts of the work in turn, adjusting your idea of the final deadline in the light of the rate of progress you are achieving in practice.

Session 5 — Look at the overall program design and get the programmer to explain it to you until you understand it. Don't let him blind you with science — good logic can be explained perfectly well in English or with the aid of simple diagrams. Repeat this process for individual program modules.

Sessions 4 and 5 are then repeated for the program coding, except that the programmer should not be able to demonstrate the programs working on the machine. It is worth his while demonstrating individual program modules even if this means he has to arrange to be able to type in data items that the full program would have collected from files, or if he simply has results flashed on the screen that would eventually go into a full-blown report. Although this seems to involve extra work in the coding, it saves much more time in the testing stages and enables all concerned to have a better idea of how the work is progressing.

Program testing and implementation must then be similarly broken down into their stages and each stage checked off in turn. Although this seems to take up a lot of time, it saves the time that might have been wasted when serious errors showed up too late and it also keeps the project under better control.

Getting ready for testing

It is very important to bear in mind when you are designing programs and getting them written that you have to be able to test the programs and also that you have to be able to get your data into them in the first place. Next month I shall be following up the idea of the structured walkthrough to show how testing can be integrated into the programming effort.

LEISURE LINES

by J J Clessa

Winner of Leisure Lines Puzzle No18

Another relatively easy puzzle — about 130 entries received although almost 20 of these were incorrect. The correct answer was that Mr Baker is the parson — and we don't think it's necessary to give a detailed explanation of the logic behind this.

Random selection gave the winner as Mr C C Kuan of London NW4.

Congratulations Mr Kuan, your book token is on its way.

Quickie

Which are there more of: square yards in a square kilometre or millimetres in a mile?

Prize puzzle

1 Using the digits 1 through 6 inclusive and using each digit once only, form two numbers x and y.
2 Calculate:
Sum, S=x+y
Difference, D=x—y
Product, P=xy
Quotient, Q=x/y
3 Finally, evaluate the expression:
E=P.D—Q.S
4 The object is to choose x and y to give the largest possible value of E.
5 Thus, suppose the numbers chosen were:
x=1234 and y=56
S=1290
D=1178
P=69104
Q=22.03571
and E=81,376,086. (Give E as a rounded integer.)

Answers please giving x, y and E on a postcard only to arrive not later than 31 May to: Puzzle No 20, *PCW*, 14 Rathbone Place, London W1P 1DE.

This month's prize is a beautiful Faber Castell automatic pencil. (I wonder if it writes by itself?)

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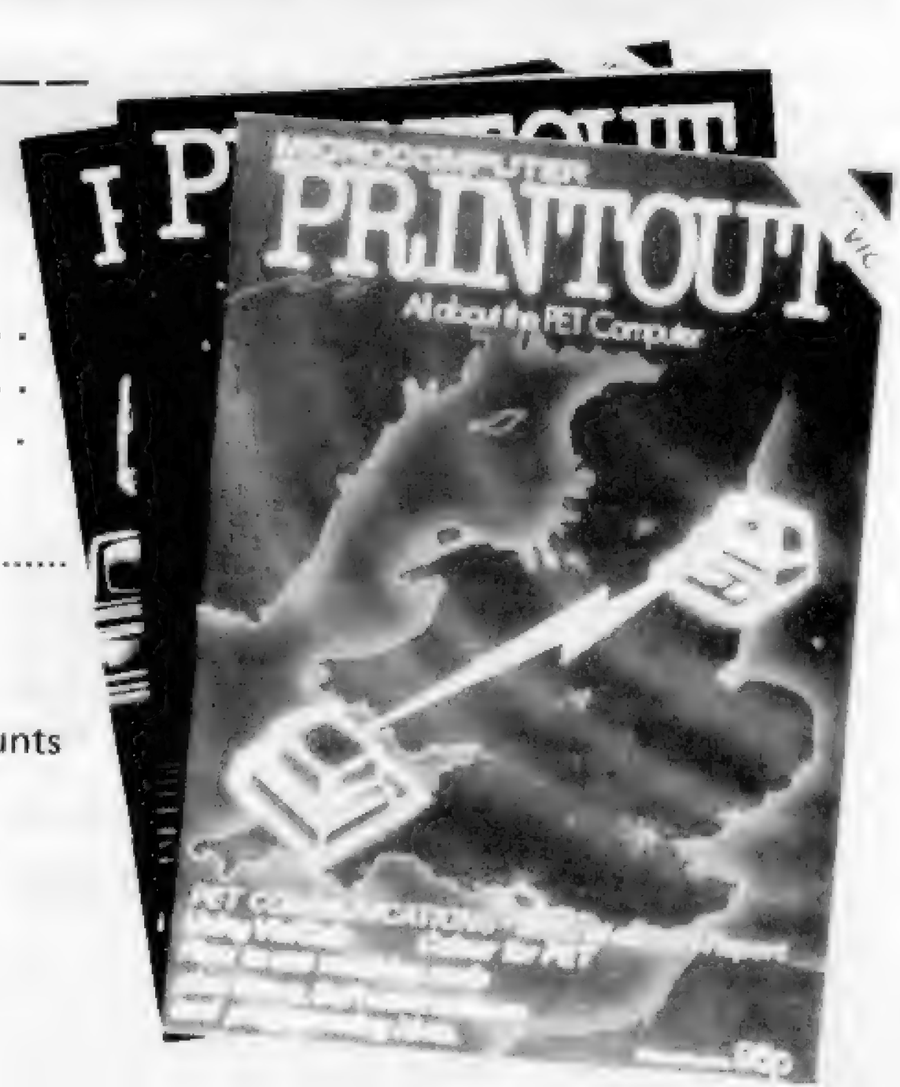

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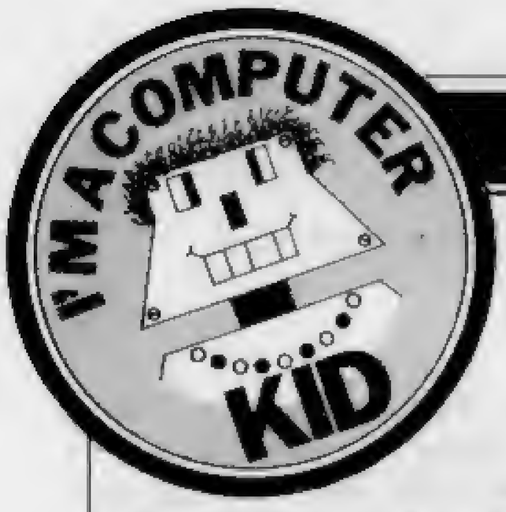


YOUNG COMPUTER WORLD

Compiled by Derrick Daines

What is a mug trap? That's easy — it's a trap for mugs! The sort I have in mind is the character who doesn't know one end of a keyboard from the other. You know who I mean — the computer prints out something like: 'PLEASE INPUT A NUMBER 1 TO 207' and this poor soul gasps anxiously, 'What do I do?' and pokes at every key in sight — very often a character key. As a result the computer curtly says: 'RE-ENTER?' which throws him into a greater tizzy than before.

Then there's the chap who dithers. He knows what he wants to type, but can't find the right keys. 'WHAT IS YOUR NAME?' asks the computer, and because of his dithering, the dumb mutt is addressed as '&TO' (MM+y' for the rest of the program.

The mug that I best like to catch, however, is the Smart-Alec type. You've met him. 'INPUT A NUMBER 1-207' says the computer, and our wise-guy giggles, 'Let's see what your computer makes of this!' and types in 123456789 0987654321 or something.

All of these mugs — and many others — can be caught by a well-thought-out mug trap. The best that I ever heard of was from one chap who couldn't understand why the program didn't behave as he expected it to. 'YOU ARE AN IDIOT!' he typed. Quick as a flash, the computer came back with: 'SO ARE YOU!'

Mind you, I've also got to add that all of us make stupid entries at some time or another and if there's anything more annoying than having to retype a lot of data into a program because of a stupid mistake, then I've yet to find it.

The problem with mugs is that unless their silly entries are trapped, they can crash a whole program and, incidentally, perpetuate the myth that you've got to be a whizz-kid before you should be allowed anywhere near a computer. Now, one programming cliche or proverb says that in the event of a wrong input the program should decline gracefully, not dramatically. In other words, it shouldn't crash or produce nonsensical output, but should politely point out the error and request another entry.

I say 'politely' because it won't help, you know, if the computer tells you that you're a steaming nit — that sort of response has been known to prompt folks to put the boot into the equipment.

Another problem with mug traps is that if you're not careful they can take up more program space than anything else. I recently completed a program for learners and was shaken to realise that instructions, menu and mugtraps together took up five times as much space as the program proper. I was even more shaken when I realised that the 'real' program revolved around the repeated working of just three lines of Basic! If I was writing for myself, a dozen lines would have been adequate, but because I was writing for others, an extra 100 lines had to be written to prevent dramatic crashes and to provide 'user friendliness'.

A typical mug trap in Basic might look like this:

```
100 INPUT "PLEASE TYPE A
    NUMBER 1 — 20", Q
110 Q = ABS (INT Q)
120 IF Q>0 and Q<21 THEN GOTO
    150
130 PRINT "SORRY — YOUR
    NUMBER IS OUT OF BOUNDS"
140 GOTO 100
150 REM — REST OF PROGRAM
```

As it stands, it's not a bad mug trap, but it can be improved. Can you do any better? Have you got a few lines of program designed to trap a type of mug? I would be very interested to hear from you and I'll give book tokens for all mug traps published. I don't mind what sort of mistakes your trap is designed to eliminate — I'll leave that up to you — but we'll stick to Basic, if you don't mind. Pilot for instance provides excellent facilities for trapping out the smart-Alecs who log themselves in as Mickey Mouse, and it wouldn't be fair to compare that trap in Pilot with a similar trap in Basic.

I am confident that there are plenty of folks who have devised some really cute mug traps. Perhaps the traps are part of programs that the owners do not feel are worthy for submission as a whole, but here is your chance to shine. Let us have the mug trap *only!* Remember — book tokens for all published.

Programs received

Crickety by Hugo Clark (15) of Nottingham;
Space Mines by Stephen Oliver (16) of Chester-le-Street;
Air Attack by P Lloyd (14) of Tuebrook;
Space Intrusion by M Morris (16) of Kingswinford;
Tennis Trainer by Anders Quarnstrom (16) of Helsingborg, Sweden;
Peter's Space by Peter Watts (12) of Pinner, Middlesex;
Morse Code Trainer by Jonathan Roberts (16) of Ilford;
Quiz Program by Luke Fitzgerald (10) of Reading.

That's a lot of goodies! If this keeps up, I'm just gonna hafta buy myself a Tandy, a PET, an Apple, a ZX80, an Atom, etc, just so that I can play all these smashing games. I reckon Space Invaders has got a lot to answer for, though!

I was very impressed with young Luke's quiz presentation. Not only did he provide a listing *and* a flowchart but his quiz didn't contain a single question! That's right! He has written a drive/presentation routine that reads a named quiz from tape. So you load the standard routine, run it, and it prompts you for the name of the text tape! No need to change all of the quiz — just change the text tape. That's real forward thinking for you.

J Roberts' Morse Trainer uses a soundbox to generate morse code that the user must identify. It set me to thinking: how long will it be before the telecommunications examination for sending and receiving Morse will be obsolete? With just one small dedicated microprocessor added to the radio, the operator could type his message!

Trevor Watson of Newbury was prompted to write in by the piece I wrote about kit construction a while ago. 'What is one supposed to make,' he writes, 'of a kit which shows the same capacitor in *two* places, provides six unnecessary resistors, four incorrect capacitors, no spares and no transistor?' (A crystal set?)

He concludes, 'yes, one certainly needs care, skill and luck. I suggest also a knowledge of electronics, a components reference book and a reasonable idea of computer jargon.' Mmmm. Ready access to a radio spares shop, too, I think. Would any supplier of kits care to say a few words?

By the way, the kit-built computer of which I wrote *still* doesn't work, despite expert help over dozens and dozens of hours. On the other hand, five similar kits worked right off! Must be one of those Monday machines I hear about. . .

Several new computing magazines have blown my way recently, published by colleges, universities, etc. The educational computing scene is really livening up! A fuller write-up must wait, but one of the more promising is called *Micro-Scope*, published by Newman College, Birmingham. The name is an acronym for MICROcomputer Software Co-operation for Primary Education (that's clever!) and contains the usual mixture of articles, programs and cartoons. However, the presentation is better than most and their stated future plans look very good indeed. Interested readers should write to Roger Keeling, Newman College, Genners Lane, Bartley Green, Birmingham B32 3NT. More on this next month.

BOOKFARE

Malcolm Peltu investigates some introductory tomes while Don Finlay brings news of a great book for serious computer music freaks.

Computing's not the simple life

'The best way to look at computers is the same way you'd think of a motor car or a washing machine or a Kleenex.' That is a prime specimen of the latest Computing Myth.

It comes from *The Good Computing Book For Beginners* by Dennis Jarrett and succinctly encapsulates the myth that information management is simple just because it is easy to write a Basic program. It is a myth which equates programming and personal computing with the whole spectrum of problem analysis, systems theory, information and behavioural sciences and the other related techniques which comprise information systems.

In this month's 'Bookfare', I would like to explore the reality behind this myth through three books. Firstly, there's Jarrett's paperback, primarily a comprehensive but idiosyncratic personal computing glossary. The US computing consultant Carol W Brown pitches in with *The Minicomputer Simplified*. And from an apparently unconnected source, Patricia S Warrick has some interesting things to say about the complex interaction of a variety of computer-related issues in her book *The Cybernetic Imagination in Science Fiction*.

In the Preface on the first page of his *Good Book*, Jarrett comments: 'A computer is primarily a functional object — it *does* something. You don't necessarily need to know anything about how or why it works, or how it is made: all you really need is a list of instructions about how to use it. . . once you realise how easy programming really is and how easy it is to hand the computer a new program to beaver away with, there's really no limit to the kind of things a computer can do.'

With an admirable brevity that characterises much of the *Good Book*, Jarrett manages to introduce and confuse three different activities. Firstly, the computer as 'device' is a perception that is valid when computing power has been wrapped up in a neat package, such as an automatic cash dispenser or digital watch. Secondly, to say that programming is easy is valid only for *some* programming tasks. Programming is *not* synonymous with computing. Thirdly, to claim that there is no limit to what computers can do inevitably implies that computing is more complex than just being concerned with solving simple programs written in Basic.

In order to bolster his Born Again belief in computing simplicity, Jarrett resurrects some myths dredged from his own self-confessed days of transgression among dinosaur large computers in prehistoric days, all of ten years ago: 'Too many people hold too many rigid and unsubstantiated beliefs about what computers are, what they can and can't do, how and why they work,' he proclaims. 'This book is going to change all that,' he adds modestly. Yes, by substituting new myths.

The myths he proclaims that the unenlightened still believe include: computers can think, are large, bureaucratic, expensive, have flashing lights, are run by large companies and go wrong all the time. Computers aren't necessarily like that, he adds, though 'some people would like you to think so.' Nothing like a bit of vague conspiracy to spice the flavour of a few prejudices. Of course there are some people who hold these giant computer myths to be true. But, as Rodney Dale and Ian Williamson pointed out in their *Myth of the Micro*, there is a much newer myth that, thanks to the micro, 'computers are shrinking out of sight.' You plays your prejudice, you takes your mythical choice.

Jarrett makes a common mistake of science 'popularisers'. In the search for easy–to–understand descriptions of complex ideas, he pretends the ideas behind the science are simple. Just because the notion of splitting an atom *sounds* simple, however, does not mean that nuclear physics *is* simple. Although he gives a good, relaxed 'feel' for many computing manifestations, particularly for personal computing enthusiasts, he gives a little real sense of the deeper structures beneath the surface.

The *Good Book* would have been much better if it had started with fewer pretentions and had focused its target audience more clearly. Much of Jarrett's good work in terms of its laid-back, easy reading description is spoilt by a failure to distinguish between fact and opinion and, at times, a tendency to be misleading or inaccurate.

On the cover, the publisher trumpets: 'All you need to know about computers (and nothing you don't).' Well, it doesn't contain everything 'you' want, given that it is aimed at the broadest spectrum of people. It also tells you things you don't really need to know about, like the meanings of boustrophedon, kludge and typesphere. Jarrett leads with his chin by claiming that other introductory books and dictionaries are usually dull, boring or out-of-date. The press puff issued with the book claimed: 'At last — a weighty, authoritative, comprehensive (and British!) introduction to the microcomputer at a price everyone can afford!'

Yes, it is British and it is cheap. But so are at least half a dozen other books on the market, like *The Myth of the Micro* and the two *Micro Revolution* books by Peters Large and Laurie. Robin Bradbeer's *Personal Computer Book* is weightier (I weighed it), more practical and straightforward, and Martin Banks' *Living with the Micro* is more witty (to my taste) but without being as simplistic.

To accuse dictionaries of being dull and boring misses the point, revealing a major flaw in the *Good Book*. Dictionaries are generally dull and boring because they are a reference aid. Accuracy, consistency and comprehensiveness are the critical factors. The *Good Book*'s glossary, however, seems to have been written to be read like a book. As such, its (groan!) jokes (eg 'a semiconductor is Malcolm Sargent when he was still a church organist'), its inconsistent treatment for entries on the same ilk (some companies get straightforward listing, others are dismissed with uninformative throwaway comments), its strange omissions and frequent inaccuracies are acceptable.

But as a handy ready reference, these traits become at best irritating, at worst misleading. For example, why include Apple but not Texas Instruments, Rodnay Zaks but not Adam Osborne, viewdata but not teletext? Why state that ICL 'tends to make big computers and sell them in the public sector' when the significant thing about ICL is that it is tending to sell smaller systems and public contracts are a small percentage of its sales? Why dismiss MicroFocus as a 'company that happens to have a competitive version of Cobol called CIS-Cobol' without pointing out the significance of CIS-Cobol in bringing Cobol to micros? Why, after criticising other books for being out-of-date, include entries (eg for Sinclair) which are likely to become out-of-date quickly? And why, oh why, is there no entry for structured programming? (After all, the book is supposed to be aimed at trainee DP people as one of its audiences.)

I am sure that many people will enjoy reading the *Good Book* and will get a lot of good advice out of it. Old computer hands will, in particular, find much of it amusing. Beginners will find its introduction before the glossary very readable but it isn't as full as other books because so much is organised and presented as the glossary.

The *Good Book* will perform a valuable service if it convinces beginners that computing can be fun and is worth pursuing. But I am afraid that it will start off too many people on the wrong simplistic footing.

Incidentally, the entry in the glossary for *PCW* is both inaccurate and irrelevant. And the entry for *Practical Computing* — 'the top British magazine for the personal computer buff' — is, I'm sure, a purely objective and unbiased view and not at all connected to the facts that Jarrett was *PC*'s first editor and the *Good Book*'s publisher happens to be *PC*'s first publisher!

Telling it how it is

The blurb on the cover of Carol Brown's *The Minicomputer Simplified — An Executive's Guide to the Basics* sounds as pretentiously overblown as that for the *Good Book*.

'How to understand computerese,' it puffs and (here we go again), 'How to demystify the programming mystique.' But it also claims much more practical aims. How to choose the right minicomputer, to tell the 'vendor' (it's an American book) what you want, to

negotiate a contract, to document a system.

But whereas Jarrett splayed his gunfire in the hope of catching a multitude of game, Brown fixes her sights firmly on a single target — management executives responsible for implementing a small business system (it applies equally well to micros as well as minis).

If I were a theatre critic, I would describe Brown's book as 'A Hit! A Palpable Hit!' She simplifies the description of the technology but never pretends that implementing business computer systems is easy; in fact, she offers a great deal of practical and fairly detailed advice on how to manage the difficulties and complexities. Although the book is comprehensive, it is never heavy. Because the jokes and lightheartedness (such as a chapter headed 'The Care and Feeding of Minicomputers') are rooted firmly in grassroots practically, they never intrude.

When Brown says she is giving 'Enough computer jargon to get by on,' that is just what she does, in eight easy-to-read pages. And she does not get drawn into the more esoteric byways of Jarrett's glossary. Unlike many other American writers, Brown also avoids consultantese and verbosity.

Her descriptions are frequently both funny and illuminating, a difficult task with a technical subject. She even finds a relevant new angle on the old bug metaphor: 'Program bugs, like cockroaches in the kitchen, hide; they choose their own time and place to venture out. Only the patient and vigilant have a chance to eradicate them. Even then, the process of battling one bug may allow another bug to go unnoticed.' That is a good example of how to explain a technical problem in a way that is understandable and accurate.

Throughout the book there are neat nuggets of advice. On programming, for example, she suggests; 'assume that the program does not work at all and then, by thorough testing, prove it does.' In a section on interactive computing, she expands this into some derivation of Murphy's Law (that if something can go wrong, it will go wrong). Assume the operator is a gorilla, she advises, who will key the wrong thing at every opportunity. Give the operator lots of assistance by providing a meaningful dialogue of prompts and error messages. Assume that the line printer will malfunction during every job. . .

By pinpointing these practicalities, she graphically brings to the fore the need to build safeguards into the design. She also avoids trying to suggest that computers are a magic wand that will always succeed in improving business and profitability. (This myth is currently being promoted by the British government in its propaganda campaign to stampede British management into joining the 'micro' revolution.)

Companies who want a computer mainly because 'business is sick and a computer will fix it' will find that the result is a computerised sick business, she warns. Don't get a computer just because a competitor has got one — how do you know that the competitor isn't making a cock-up of computerisation, she asks?

After a lot of sound advice on how to go about feasibility studies, choosing consultants and systems, etc, she ends up with a Horror Story case study of what can go wrong. She also likens a computer to a motor car. But whereas Jarrett said a computer was a device like a motor car or Kleenex, Brown uses the analogy to say that, just as there are many different colours and types of cars, so are there many types of minicomputers. (The analogy is still poor, I think, but not as misleading as Jarrett's.)

The Minicomputer Simplified is *not* the Ultimate Source for computing information. It has a limited vision, fixed within the traditional ethos of business minis. It has little to offer the non-business personal computer enthusiasts, although it is relevant to the businessman interested in micros. It is glib in its comments on the employment consequences of information technology and barely touches on the wider impact on business of information technology and the micro, such as the electronic office and integrating telecommunications and other services.

This limited vision, however, is the book's strength. Its market is clearly defined, frills that fall outside this aim are avoided and, most of the time, it hits Bull's Eye on its narrow target.

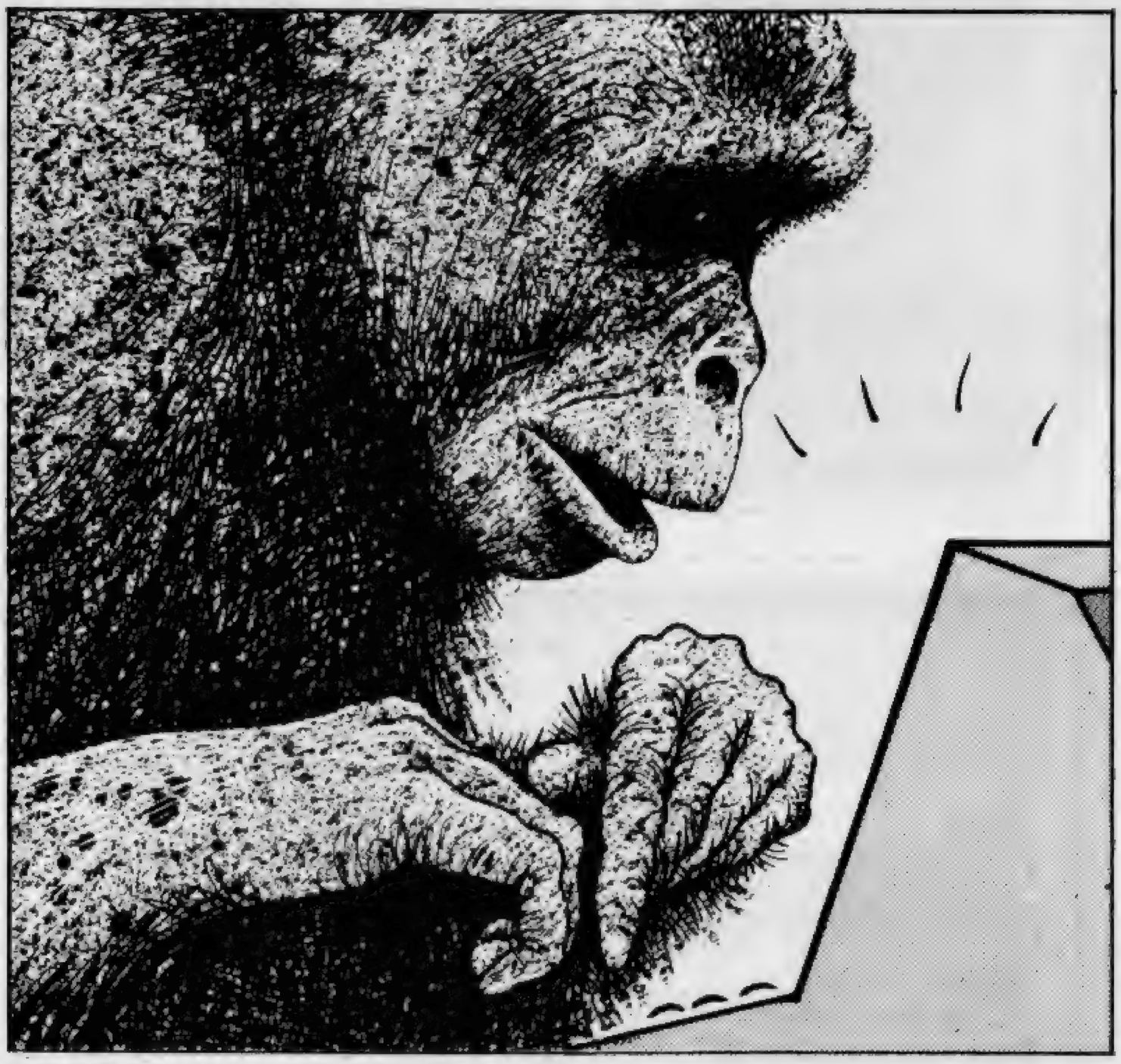
Man and computerman

Cybernetics is a branch of information theory and computing technology which takes us to the opposite extreme of the image of computer as Kleenex. It raises the question of just how far intelligent machines can evolve towards those qualities which are regarded as human.

In *The Cybernetic Imagination in Science Fiction*, Patricia Warrick turns a review of certain sci-fi literature into an informative and interesting book that analyses the nature of cybernetics and of the way cybernetic images reverberate throughout time, starting with early myths. (Greek mythology, not Micro Myths.)

Cybernetics is far from simple. As Warrick explains, 'Cybernetics comprises all systems, mechanical and biological, in which information plays a role. Information theory, DNA theory and general systems theory aim at describing the function of cybernetic systems.' She also says that information processing, computer science and artificial intelligence bring into focus arguments about the nature of consciousness. She then uses examples from (mainly American) science fiction to see how the artistic imagination has used cybernetics and robots as a springboard to explore many vital human anxieties, hopes and aspirations.

She offers sufficiently explicit summaries of key works to enable her thesis to be understood even by people who have not read the books. As she points out, many sci-fi stories are so



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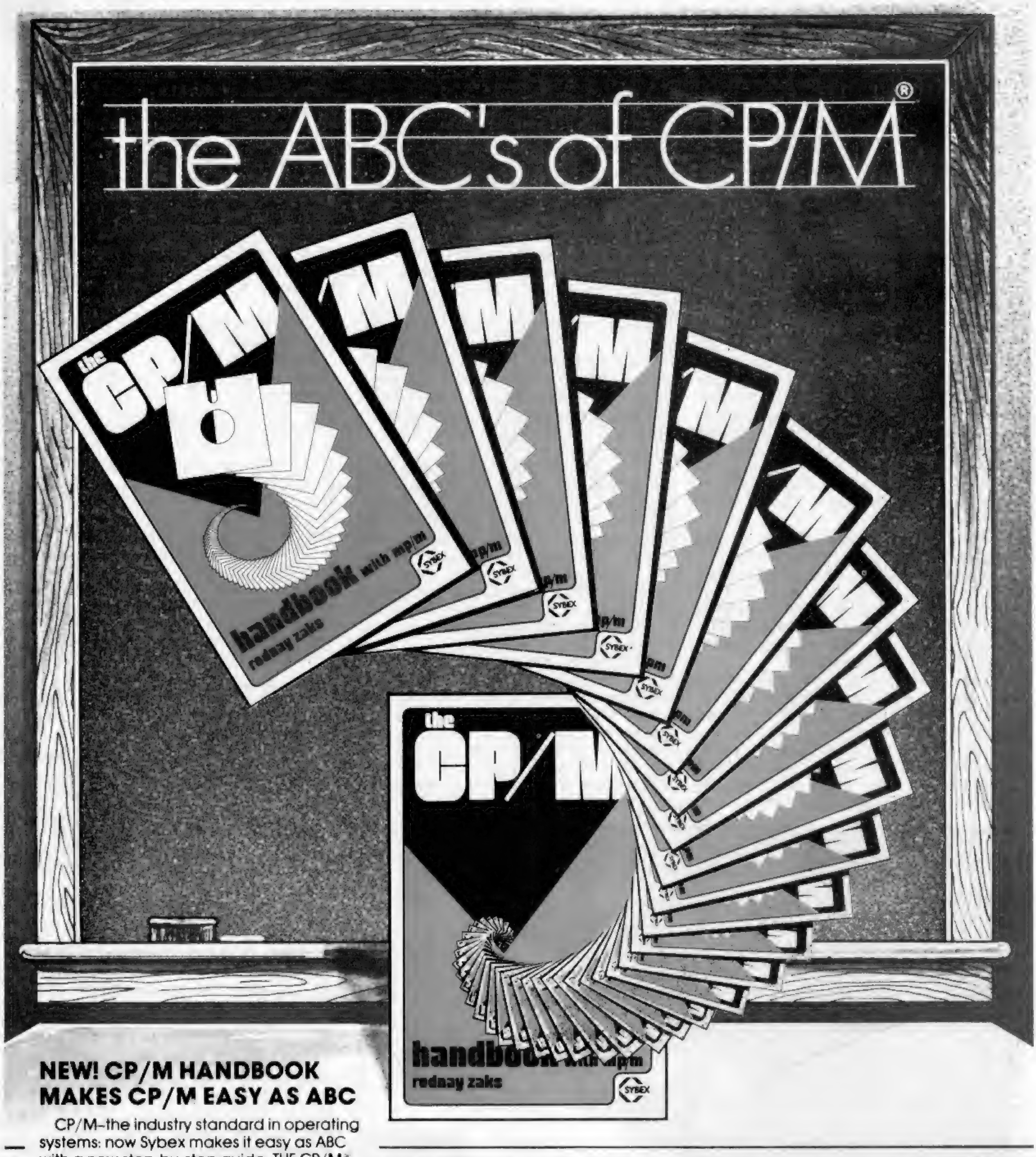

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BOOKFARE

devoid of characterisation and are so essentially based on an extrapolation of ideas and puzzle solving, that a summary of the stories is probably just as good as reading the whole thing. But she does point out where there is literary as well as scientific intellectual merit in particular books.

She ranges widely through philosophy and literature, science and mythology in tying together her many threads. Occasionally, she boxes herself into a Pseud's Corner and her division of works into categories like 'Isolated-System' and 'Closed-System' models is unnecessarily confusing. I recommend it however, because it explores a wide variety of issues relating to the impact of computers in a thorough, factual way, as well as venturing into imaginary realms.

If you are a sci-fi freak, *Roderick* by John Sladek is a new book in the cybernetic genre. It is about a robot called Roderick and his (its?) journey through life from amoebic electronic brain to something approaching human form. As literature, it is more in the tradition of *Catch 22* and other 'zany' satire than sci-fi. I didn't like the style; I found it tough going at times. But there were sufficient jokes and one-liners to make the going easy. Like when Roderick's adopted father bashes Roderick's head in saying, 'Heads are wonderful things. Nobody should be without one.'

And there is the redneck police chief who believes that computing people are repressed 'faggots, sadists and what have you.' His reason is the 'kinky' words he found in a computing mag. Words like bit, byte, RAM, gang punch, debugger, stand-alone software, Texas Instruments (ever wonder what a Texas Instrument is?). Or a Honeywell?

Warrick argues that sci-fi is embedded in the 'poetic tradition, eschewing realism and plumbing the imagination for metaphors.' In Roderick's case, plumbing the imaginative depths might be more accurate. But poetry is a suitable point on which to end this Bookfare on simplicity and complexity. After all, the essence of poetry is to translate complex, profound thoughts into simple, lucid language. Simplicity and complexity are not incompatible objectives.

The Good Computing Guide for Beginners by Dennis Jarrett (EEC Publications, £1.95)
The Minicomputer Simplified by Carol W Brown (Collier Macmillan, £6.95)
The Cybernetic Imagination in Science Fiction by Patricia S Warrick (MIT Press, £10.50)
Roderick by John Sladek (Granada, £6.95)

TECHNICAL REVIEW

by Don Finlay

Musical Applications of Microprocessors, by Hal Chamberlin (Hayden 1980, £15.20)

Music has been played on wholly artificial instruments since the time when logs were hollowed and slotted for differently pitched sounds, and natural horns were modified in length and pierced with holes: the microprocessor is just the latest in a long series of technological advances adopted by musical instrument makers. Thus observes Hal Chamberlin in *Musical Applications of Microprocessors.*

This book is not for the proud owner of a home computer who wants to play simple tunes, nor is it for the programmer with access to a mainframe. Although there are some software discussions and listings, it is definitely hardware-oriented, and none the worse for that, as it must be the most up-to-date, yet comprehensive, survey of electronic music techniques in existence. An electronics engineer or enthusiast will find a wealth of information on 'how to do it', ranging from a brief survey of sound on tape methods, through analogue synthesisers, to digital filtering, the fast Fourier transform, and digital multiplexed oscillators, all explained in a very clear and non-mathematical (except where necessary for the understanding) style. The 661 pages, including index, give remarkable value at £15.20.

Section I: 'Background' has five chapters, of which the first three are introductory, on principles and analogue methods, including the voltage-controlled synthesiser. Computer synthesis forms the next chapter, and then comes the first one directly related to the title of the book, which is an historical survey and contains a rare item in the form of a comparison between LSI-11 and 6502. This contains a great deal of material which must be considered in designing a dedicated system — or sub-system, as the low cost of the chips now makes it feasible to have intelligent modules, each with its own microprocessor.

Section II is entitled 'Computer-Controlled Analogue Synthesis'. Firstly, there is a chapter on analogue modules such as the VC0, VCA, and VCF, with several circuit designs. Then conversion from digital to analogue or vice-versa, multiplexing and the first suggestion for a microprocessor-controlled module — an intelligent, 128-channel multiplexed DAC, which can alter refreshing rates to suit level changes, or carry out ramp operations independently of the main system. Signal routing makes an absorbing chapter; not many synthesisers have a computer-controlled patch, yet here is a design for an 8-in, 8-out switching module which can be replicated to control 8 VC0s, 16 VCAs four special modules and a 32-channel DAC. Fixed-voice patches — and a Synthesiser autio bus — are also considered. Again, not many computers have a musical keyboard interface; here is a design for a dedicated, 6502-controlled scanning module which allows for contact bounce and velocity sensing in its 2708 EPROM program. Sequences produced by random numbers and feedback, a description of the 'Muse' composition machine, and control sequence display and editing, with an example showing seven displayed singing speech synthesis parameters, complete this section.

Section III is the final section, and is devoted to 'Digital Synthesis and Sound Modification'. DACs and ADCs are dealt with in more detail, with an excellent guide to designing their associated filters. Digital tone generation starts with a simple sawtooth produced by seven lines of 8080 assembly language, and progresses through table look-up to the fast Fourier transform. Digital filtering has a chapter to itself, including a discussion of reverberation simulation, and leading to percussive sound generation in the following chapter.

Sound signal analysis is not overlooked, in spite of its complexity, and there is a chapter on this which deals with spectral analysis and methods of displaying the results. The difficulties of pitch detection, as required for Vocoders, are dealt with and a design from 'Electronotes' is explained.

Digital hardware is the subject of a long chapter. It starts with divide-by-N counters, top octave synthesisers, rate multipliers, accumulator dividers and phase-locked loops, and gives two suggestions for multiplexed oscillators, one of which generates 16 independent waveforms but has no provision for dynamic control, while the other is a Fourier-series oscillator more suitable for an expressive solo instrument. An intelligent oscillator, which can accept high-level commands, is suggested, and a modular digital synthesiser. Where cost prevents the all-digital approach, a hydrid system may be preferred, and a design for a hybrid 'voice module' is presented — although I for one would not like to try to build a number of these in a synthesiser, as the digital section alone needs about two dozen chips, and the analogue circuit has many more components. There is also a brief description of two commercially available digital 'voice-per-board' modules, by Solid State Music and Alf respectively, which as far as I am aware have not been advertised in the UK and could be of considerable interest.

Finally comes a chapter on music synthesis software. The hierarchy is discussed, deducing that at least five different levels can be identified. The listing for a 6502 fixed-point arithmetic package is given by way of illustrating arithmetic procedures needed. Two more listings, with discussion, cover a generalised digital filter and Fourier synthesis. The author's own NOTRAN (note translation) system, for organ music, is described in some detail.

If this review reads like a catalogue, it is because there is so much information on many topics that it is difficult to choose between them. The book should be on the shelves of every electronic music studio where development work goes on, and its style, clarity and content make it an invaluable aid on computer interfacing to audio and signal processing systems.

TO BUY OR NOT TO BUY?

That is the cliche

Save £££s with 'Tiger' Tom Moriarty's introduction to the wonders of discounted cash flow techniques

In this article I will explain how time and money are related and how we may calculate the effect of one on the other. A computer program is included which does the necessary calculations and which may help the businessman to evaluate projects and make financing decisions. It may also help the householder to decide about Hire Purchase, home improvements, etc. Full explanations of the program are given so that it may be run on almost any computer with floating point Basic. Indeed, this could be a good starting point for businessmen who have bought a computer to run professionally written software, but feel they should get into programming themselves.

Time and money

Money in your hand now is worth more than money to be paid to you at some time in the future. However, you may sometimes wonder if you should spend some money now in order to get — or save — more money later on. If the savings are very large in relation to the cost, the decision is easy. For example, you may have to decide whether to spend £10 on a bus or train pass. If the savings will be £1 per week for the next year (a total of £52) then you don't need a computer to help you decide to invest.

Conversely, if the savings are very small in relation to the cost of the proposed investment, you will decide quickly not to invest.

Another fairly straightforward case is where a single payment will produce a fixed income, or saving, every year for the rest of time. In this case, the saving may be expressed as a percentage of the initial investment, and the result regarded as an interest rate. If money can be borrowed at a lower rate, or if you can use money which would otherwise be invested at a lower rate, then it would seem you should go ahead. For example, some houses are held on leasehold terms, which involve paying a ground rent each year. If you own such a house, you may be wondering whether you should try to buy out the freehold, and so not have to pay ground rent any more. Suppose that your ground rent is £80 per year and that, after negotiating, you find that you can buy the freehold for £400. In this case the saving (£80) is 20 percent of the initial investment. If you can draw the money out of a building society, or borrow from a bank at a lower rate of interest, then the figures suggest you should go ahead.

Complicating factors

In the real world, most decisions are more complicated than the examples above. For instance, a project may involve committing you to more than one payment, or the savings may only last for a few years, or they may not be the same amount each year. Most likely of all, you may find that you have not got enough money to go ahead with all the projects you have, even though you believe they are all worth while. And what about inflation?

All these problems can be catered for. The basic technique used by accountants is called 'discounting'. All sums of money which are to be paid out, or received, at some time in the future are 'discounted' to find their 'present value'. The present value of an amount X at some time in the future is the amount that would have to be invested at the present, at compound interest, to give that amount X at the specified time in the future. For example, if we are considering a project which will produce a single saving of £144 in two years time, and we reckon interest at 20 percent, we realise that £100 invested now at 20 percent would be worth £120 after one year, or £144 after two years. Thus £144 in two year's time has a present value of £100. (You needn't worry about the mathematics — that's what your computer is for.)

Once all the payments and savings involved in a project have been converted to their present values, they may be added together or directly compared. This technique is called 'Discounted Cash Flow'. There are two main ways of using it, called 'Net Present Value' and 'Internal Rate of Return':

Net present value

This approach is suitable when money is available at a known interest rate, which may be because we have enough money for the project being considered, which will otherwise remain invested in a bank, building society, etc. The interest rate to be used is normally whatever is being paid by the bank, etc. Money is also available at a known interest rate if we know we can borrow it without difficulty. In either of these circumstances the computer will use the known interest rate to calculate the Present Value of all the payments and savings and subtract the one from the other to get the Net Present Value. If this is positive, then the figures suggest we should go ahead with the project. There is an example of this type of problem later on, in the section on using the computer program.

Internal rate of return

The second approach is suitable in the more complicated, but more usual circumstances where there are lots of projects we would like to do, but no hope of getting enough money for all of them. Here we regard each project as a separate investment, and see what interest it pays. This rate of interest is the rate which would have to be paid by a bank to give you the same returns from the same investments as this project requires. In fact, it is the rate of interest which makes the Net Present Value equal to zero. This rate is called the Internal Rate of Return of the project. You then spend whatever money you have on the project, or projects, which give the best return. Again, there is an example of this type of problem near the end of the article.

How the program works

Lines 10 to 42 are headings, giving information to anyone who wants to work on the program in the future. Lines 50 to 80 initialise some of the variables used. Lines 90 to 320 get the user to enter the necessary data. (See following example for details of data to be entered.) Lines 350 to 495 present the user with a menu to enable him to select what he wants to do and jump to the appropriate section of the program.

If the user wants to do a Net Present Value calculation, the program jumps to line 1000, where it asks for the interest rate to be used, then calls the subroutine at lines 500 to 590 to calculate a discounted cash flow (DCF) table and finally jumps to the section starting at line 700 which displays the table on the VDU screen.

If the user wants an Internal Rate of Return, the program jumps to the section 1100 to 1220. This section sear-

```
10 REM DCFLOW = DISCOUNTED CASH FLOW PROGRAM
20 REM BY T MURPHY
30 REM C( J ) = CAPITAL EXPENDITURE IN YEAR J
32 REM S( J ) = SAVINGS IN YEAR J
34 REM D( J ) = DISCOUNT FACTOR FOR YEAR J
36 REM P( J ) = PRESENT VALUE OF NET CASH FLOW IN YEAR J
38 REM R = INTEREST RATE IN PERCENT (FOR 10%, R=10. NOT 0.1)
40 REM N = NUMBER OF YEARS ASSUMED LIFE OF PROJECT
42 REM N$=NAME OF PROJECT
44 REM R2=INFLATION RATE FOR SAVINGS
50 DIM C(30),S(30),D(30),P(30)
60 FOR J=0 TO 30
70 C(J)=0:S(J)=0:D(J)=0:P(J)=0
80 NEXT J
90 INPUT "NAME OF PROJECT",N$
100 INPUT "NUMBER OF YEARS",N
105 IF N)30 THEN PRINT "TOO MANY - MAXIMUM 30":GOTO 100
110 PRINT "INPUT CAPITAL EXPENDITURE PER YEAR"
120 PRINT "GIVE YEAR )";N;"TO FINISH"
130 INPUT "YEAR",Y
140 IF Y)N GOTO 200
150 INPUT "CAPITAL EXPENDITURE",C(Y)
160 GOTO 130
200 PRINT:PRINT"INPUT SAVINGS PER YEAR"
210 PRINT"FIRST GIVE AMOUNT OF CONSTANT SAVING PER YEAR"
212 PRINT"THEN INDICATE IF THIS AMOUNT IS TO BE INFLATED"
220 PRINT"THEN ENTER AMOUNTS OF EXCEPTIOAL SAVINGS IN PARTICULAR YEARS"
230 PRINT
240 INPUT"CONSTANT AMOUNT ",S
245 INPUT "ANUAL INFLATION PERCENTAGE",R2
250 FOR J=1 TO N
260 S(J)=S
262 S=S*(1+R2/100)
265 NEXT J
270 PRINT:PRINT"GIVE YEAR )";N;"TO FINISH"
280 INPUT"YEAR IN WHICH SAVING IS DIFFERENT",Y
290 IF Y)N GOTO 350
300 INPUT "EXTRA SAVING",S
310 S(Y)=S(Y)+S
320 GOTO 280
350 FOR J=1 TO 24:PRINT:NEXT J
370 PRINT "N = CALCULATE NET PRESENT VALUE"
380 PRINT:PRINT:PRINT"I = CALCULATE INTERNAL RATE OF RETURN"
390 PRINT:PRINT:PRINT"D = DISPLAY MOST RECENTLY CALCULATED DISCOUNT TABLE"
400 PRINT:PRINT:PRINT"P = PRINT OUT MOST RECENTLY CALCULATED DISCOUNT TABLE"
410 PRINT:PRINT:PRINT"S = STOP"
420 PRINT:PRINT
430 INPUT A$
440 IF A$="S" THEN STOP
450 IF A$="D" GOTO 700
460 IF A$="N" GOTO 1000
470 IF A$="I" GOTO 1100
480 IF A$="P" GOTO 1300
490 PRINT A$;" NOT AVAILABLE";CHR$(7)
495 GOTO 430
500 REM SUBROUTINE TO CALCULATE TABLE
520 P1=0
530 FOR J=0 TO N
540 D(J)= ( 1 / (1+(R/100)) )^J
550 P(J)=(S(J)-C(J)) * D(J)
560 P1=P1+P(J)
580 NEXT J
590 RETURN
700 REM SECTION TO DISPLAY TABLE ON SCREEN
710 OPEN "KB:"FOR OUTPUT AS FILE 1
720 S=1
730 GOSUB 800
740 CLOSE 1
750 INPUT "RETURN TO MENUE",A$
760 GOTO 350
800 REM SECTION TO OUTPUT TABLE TO SCREEN OR PRINTER
810 PRINT £1,CHR$(12)
820 PRINT£1:PRINT £1
830 PRINT £1,"          DISCOUNTED CASH FLOW TABLE   -     ";N$
840 PRINT £1: PRINT £1
850 PRINT £1,"INTEREST RATE =";R;"%"
860 PRINT £1
870 PRINT £1,"YEAR            CAPITAL          SAVINGS          DISCOUNT          PRESENT"
880 PRINT £1,"                                                 FACTOR            VALUE"
890 PRINT £1
900 FOR Y=0 TO N
910 PRINT £1,USING"£££";Y;
915 PRINT £1,USING "£££,£££,£££,£££.££";C(Y);
916 PRINT £1,USING "£££,£££,£££,£££.££";S(Y);
917 PRINT £1,USING "£££,£££,£££.££££";D(Y);
918 PRINT £1,USING "£££,£££,£££,£££.££";P(Y)
920 IF Y=15 THEN IF S=1 THEN INPUT"O.K. TO CONTINUE",A$
930 NEXT Y
940 PRINT £1:PRINT £1
950 PRINT £1,"NET PRESENT VALUE =";P1
970 RETURN
1000 REM SECTION TO DO NET PRESENT VALUE CALCULATION
1010 PRINT:PRINT:PRINT
1020 INPUT "INTEREST RATE",R
1040 PRINT "WAIT"
1050 GOSUB 500
1060 GOTO 700
1100 REM SECTION TO CALCULATE INTERNAL RATE OF RETURN
1120 PRINT "WAIT"
1140 R=0:S1=1:P2=1
1150 GOSUB 500
1160 IF P1*P2 < 0 THEN S1= -0.5*S1
1170 IF ABS(S1)<0.005 GOTO 1200
1180 R=R+S1
1184 P2=P1
1190 GOTO 1150
1200 PRINT USING "INTERNAL RATE OF RETURN = ££££.£££ %";R
1210 INPUT "RETURN TO MENUE",A$
1220 GOTO 350
1300 REM
1310 REM SECTION TO PRINT OUT MOST RECENTLY CALCULATED TABLE
1320 OPEN "LP:" FOR OUTPUT AS FILE 1
1330 S=0
1350 GOSUB 800
1360 CLOSE 1
1370 PRINT "TABLE SENT TO PRINTER - RETURN TO MENUE";
1380 INPUT A$
1390 GOTO 350
```

TO BUY OR NOT TO BUY?

That is the cliche

ches for an interest rate R which will give a Net Present Value P1 nearly equal to zero. As a first guess it sets R equal to 0. It then calls the same subroutine at lines 500 to 590 to find the Present Value. With R=0 the present value will usually be positive. R is then increased by S1, ie by 1, the most recent value of P1 is stored as P2, and the subroutine at line 500 is called again. This procedure is repeated until a value of R is found which gives a negative P1. This value is now too high, so S1, the step by which we have been increasing R, is multiplied by —0.b. Thus the procedure is repeated with R being stepped back in smaller steps until P1 again becomes positive. We continue to step R back and forth in smaller and smaller steps until the step is less than 0.005, which means we are as close as we are likely to want. This is not the fastest or most elegant way of finding the value of R, but it works and does not need many lines of program.

This program was written for a computer with both a VDU and a printer. It was designed so that most of the output appears only on the VDU screen, but the DCF table can be printed on the printer if required. Both the section 700 to 760 (for displaying the table on the screen) and section 1300 to 1390 (for outputting the table on the printer) use the subroutine at lines 800 to 970 to do the actual layout of the table. The statement at line 710 causes print statements with the £ symbol to output to the VDU terminal; the statement at line 1320 causes the same print statements to send their output to the line printer instead.

Modifying the program for your computer

If your computer has no printer, you may omit lines 400, 480, 720, 740 and 1300 to 1390. You may also omit the £ from the print statements where it appears. If your computer has a printer, but requires different commands to route output to fit, then you must modify these lines as required.

Most Basic dialects accept multiple statements on one line, separated by colons. If yours doesn't, lines like 70 will have to be split into a number of separate lines.

This program was designed for use with a VDU having 24 lines of 80 characters. If you have fewer lines, omit some of the print statements at the start of lines 380 to 420.

The symbol in front of the J on line 540 is the sign for raising everything in the brackets to the power of J. In some versions of Basic, this should be replaced by a pair of multiplication signs, ie '**'.

PRINT USING is used in this program to print out columns of numbers with the decimal points in line, and with commas as required to separate digits into blocks of three. If your Basic does not allow PRINT USING, you can simply omit the word USING and the string between quotes in these print statements. You will then want to do something to tidy up the printout and get the numbers to line up. The simplest would be to replace lines 870 and 880 with:

```
870 PRINT "YEAR","CAPITAL",
      'SAVINGS","DISCOUNT",
      "PRESENT"
```

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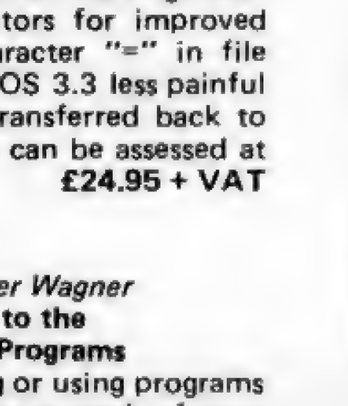

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880 PRINT " "," "," ", "FACTOR", "VALUE"

and to replace lines 910 to 918 inclusive with a single line:

910 PRINT Y,C(Y),S(Y),D(Y),P(Y)

Line 1200 becomes:

1200 PRINT "INTERNAL RATE OF RETURN=";R;"%"

Two special control characters for the VDU terminal are output by this program. The first is at line 490, where the PRINT statement includes CHR$(7). This is the ASCII code for BEL and causes the terminal to make a noise. If your computer does not provide this facility, simply omit the CHR$(7) and the semicolon before it.

The second special character is CHR$(12), the ASCII code for FF, or Form Feed. This causes the screen to be cleared when it is output at line 810. If it will not produce the desired effect on your computer, there may be a special command, such as CLEAR or CLS which you can use in place of line 810. Alternatively, you could replace line 810 with a copy of line 390, which achieves the same thing by printing 24 blank lines.

Modify the program as required and type it into your computer. Remember to SAVE the program on cassette or disk every now and then in case a power failure, or whatever, accidently wipes out all you have done. Then comes the big moment. Give the command RUN.

If you get an error message while entering the program, or while running it, or if you get some obviously wrong output, then the most likely problem is a typing error. LIST the part of the program that causes the problem and compare it with the original.

If you can find no difference, the next most likely problem is a difference between my dialect of Basic and yours. Look up in your Basic manual the required syntax for the statements that seem to cause the problem and change if required. For example, one point that has foxed me on a number of occasions is a difference between two dialects of Basic I use. The one used for this program accepts a comma after the string in quotes in an INPUT statement (eg line 90). The other needs a semi-colon.

If these steps fail, you can wait for the next few issues of this magazine to see if anyone else writes in with a solution to your particular problem. Much better to get stuck in, find the problem and write in to the magazine yourself. One useful trick for chasing bugs is to put in extra print statements to help you follow what's going on. For instance, if you type 51 instead of S1 in line 1170, the program will get lost whenever you ask it to calculate an Internal Rate of Return. This will happen because 51 will never be less than 0.005, so the program will get stuck in the loop 1150 to 1190 for ever, with no sign of what's going on. All you will know will be that you saw the menu, gave the command 'I', and got the message 'WAIT'. When you get tired of waiting and interrupt the program with a control Z or whatever your computer requires, you will know it got to 1120. Your first question could be: 'Did it get back from the subroutine and if so, what was happening?' You could ten try adding a statement:

1155 PRINT "BACK FROM SUB. R=" ;R; "S1=";S1; "P1=";P1

When you run the program with this statement, you will find that it prints out a number of times, so yes, the subroutine is working. You will see the R is going up at first, and then up and down as you would expect. Then you will see that, even when the value of S gets very small, the program stays in the loop. This should suggest a closer look at line 1170. If you are so boggle-eyed at this stage that you can't see anything wrong, the best tactic may be to re-type the whole line. Finally, when all seems to be okay, enter the numbers in one or more of the examples below and check that you get the same answers I did.

Example one

When the program is running, the first thing it will do is to ask you for a name for the present project. This will play no part in the calculations, but will be printed at the top of discounted cash flow tables, to help you to avoid mixing up the output from different runs of the program.

For the first example, consider the possibility of buying a colour TV to save the cost of rental. When asked: NAME OF PROJECT? answer NEW COLOUR TV. The next question is the number of years during which savings will be made. We never know exactly what will happen, but we can make reasonable assumptions. Let's assume that a colour TV may be expected to last five years, so: NUMBER OF YEARS? answer 5. We are now asked to give the capital expenditure each year. The first obvious expenditure is the purchase of the TV. This will happen immediately, ie before any time has elapsed, so for the question: YEAR? answer 0, and, if the price is £350, the answer to: CAPITAL EXPENDITURE? is £350.

DISCOUNTED CASH FLOW TABLE - DOUBLE GLAZE

INTEREST RATE = 16 %

YEAR	CAPITAL	SAVINGS	DISCOUNT FACTOR	PRESENT VALUE
0	1,128.00	0.00	1.0000	-1,128.00
1	0.00	150.00	0.8621	129.31
2	0.00	165.00	0.7432	122.62
3	0.00	181.50	0.6407	116.28
4	0.00	199.65	0.5523	110.26
5	0.00	219.62	0.4761	104.56
6	0.00	241.58	0.4104	99.15
7	0.00	265.73	0.3538	94.02
8	0.00	292.31	0.3050	89.16
9	0.00	321.54	0.2630	84.55
10	0.00	1,353.69	0.2267	306.84

NET PRESENT VALUE = 128.79

If we own the TV ourselves, we will have to pay all repair bills. We may guess, on the basis of some experience, that these will amount to £100 after three years and another £50 in the fourth year. Thus we answer the question as follows:

YEAR? 3
CAPITAL EXPENDITURE? 100
YEAR? 4
CAPITAL EXPENDITURE? 50

We now want to go on to the next secion, but the program asks for another year. Reply with any number greater than 5 (the number of years in the project). For instance:

YEAR? 99

The computer will now ask for the constant amount of savings per year. In this example, the saving is the rental we will save, say £165 per year: CONSTANT AMOUNT? answer 165. If we assume that the rental will be fixed for the life of the contract, we may answer: ANNUAL INFLATION PERCENTAGE with 0. There will be no special savings with this project, so when asked: YEAR IN WHICH SAVING IS DIFFERENT? answer 99. The computer will now show the main menu. Let us imagine that the purchase is to be paid for with a loan bearing an effective interest rate of 23 percent, so give the command 'N' and when asked: INTEREST RATE? answer 23.

The result should be the table shown in Figure 2. The first three columns are fairly self-explanatory, repeating the inputs we have made. The fourth column gives the discount factor, calculated from the interest rate and year, by which all the cash flows in that year are multiplied to convert them to present values. In the last column the savings in each year, minus the capital expenditure in that year, have been multiplied by the discount factor. The right hand column is totalled to give the last figure in the table, the Net Present Value. As this figure is positive, it indicates we should go ahead. In fact, it tells us how much richer we will be by going ahead, if our estimates of the repair costs, life, etc, are correct.

TO BUY OR NOT TO BUY?

That is the cliche

Example two

I will continue to use domestic examples, as these can be widely understood, and businessmen can see the similarities with the problems in their particular circumstances. This example concerns double glazing, and introduces two new complications.

The first concerns the possibility of extra savings, on income, in a particular year. In this case, I assume that you do not expect to live in the same house for the rest of your life, but you would hope to get more when selling it if it has been double-glazed. For the sake of the example, I assume that you expect to sell in about ten years time, and that you would expect to get £1000 more for the house at the time due to the double glazing. Note that this refers to actual cash in ten years time, remembering that, with inflation between now and then, this will only be a fraction of the cost of double glazing at that time.

```
DISCOUNTED CASH FLOW TABLE  -  NEW COLOUR TV

INTEREST RATE = 23 %

YEAR      CAPITAL     SAVINGS     DISCOUNT FACTOR     PRESENT VALUE

 0        350.00        0.00      1.0000              -350.00
 1          0.00      165.00      0.8130               134.15
 2          0.00      165.00      0.6610               109.06
 3        100.00      165.00      0.5374                34.94
 4         50.00      165.00      0.4369                50.24
 5          0.00      165.00      0.3552                58.61

NET PRESENT VALUE = 34.9800
```

The second complicating factor is the effect of inflation on the saving you expect to make through having your house double-glazed. With the cost of fuel going up every year, you may expect the savings to increase every year. Without getting involved in the political arguments about single figure or double figure inflation, it may seem reasonable to assume that fuel prices will increase by ten percent per year on average over the next ten years. This means that the actual amount of cash saved each year will be greater than the amount the previous year (unlike the previous examples, where the cash amount of the annual saving was fixed.) Once the first year's savings and the inflation rate are entered into the computer it will calculate the actual amount of cash you expect to save each year before it applies the discount factor.

Assuming the initial cost of the double glazing is £1128 and that it will be financed by a bank loan at 16 percent, the inputs are as follows:
NAME OF PROJECT? answer DOUBLE GLAZE
NUMBER OF YEARS? answer 10
YEAR? answer 0
CAPITAL EXPENDITURE? answer 1128
YEAR? answer 99

Then on the savings:
CONSTANT AMOUNT? answer 150
ANNUAL INFLATION PERCENTAGE? answer 10
YEAR IN WHICH DIFFERENT? answer 10
EXTRA SAVING? answer 1000

The rest is similar to the first example, and the result is the table in Figure 3. Again, the positive result for the Net Present Value suggests that, other factors allowing, we should go ahead.

TO BUY OR NOT TO BUY?

That is the cliche

In our imaginary house we now have three projects to save money, ie, buying out the freehold (cost £400), buying a colour TV (cost £350) and double glazing (cost £1128). If we have not got enough money to go ahead with all three and we decide not to borrow, then we need to place them in some order of priority, so we can decide which to do first. Buying out the freehold produces a saving equivalent to 20 percent. We can discover a comparable figure for each of the other projects by asking the computer to calculate an Internal Rate of Return. The results are:

New Colour TV	28.219 percent
Double Glaze	18.156 percent

Thus these figures suggest that we will get richer quickest if we, first, buy the colour TV, then buy out the freehold and, finally, double-glaze the house.

PRINTERFACING PLUS

Peter Faff follows up his recent 'Printerfacing' series with details of interfacing a calculator to a micro to use both its printer and number-crunching capability.

The 'Printerfacing' series was aimed at people with a certain amount of knowledge of digital electronics. The idea was to give would-be constructors enough information on the various low-cost printer mechanisms available so that they could build control circuits to link a printer to their micro.

Several readers have asked if it is possible to interface their printing calculators to a micro. Yes, it certainly is possible and it can work out very cheaply if you require only a very simple printer.

Anyone building a printer from my series would have had to design some fairly complex control circuits. If, on the other hand, you decide to use a printing calculator, you will find that most of the hard work has already been done for you. These days you can buy several cheap printing calculators that use a dot matrix printer mechanism and most of these units will be suitable for modification. This approach may seem too good to be true and, as you may have expected, there is a snag. The problem is that, in most cases, you will find that you can only print numeric data along with the calculator's somewhat limited character set but for an outlay of £40 to £70, what more can you expect?

To use a calculator printer you will have to get the line of data to be printed into the calculator. The easiest way to do this is to enter the data via the calculator keyboard. Figure 1 shows a diagram of a calculator keyboard. As you can see, it comprises a matrix of single pole switches. Now for your micro to enter data into the calculator it will have to operate the keys in the correct sequence but since your micro probably has no fingers this may seem difficult. The answer is to connect an electronic switch across every key that your micro may wish to operate. You will also need a latch and a decoder so that a 4-bit data word sent by the micro can be used to operate a particular key. Figure 2 gives a block diagram of the basic system. CMOS 4066 devices should be suitable for the electronic switches although there is no reason other than expense for not using reed relays. By using a 4-bit word you will find that it is possible to operate 15 keys; if you wish to use the other facilities provided by your calculator then you could, of course, expand the word length.

The first task is to operate on your calculator. You need to trace the wires from each key back to a place where you can make a solder connection — the keyboard connector is usually the best place. When you know which lines feed what keys then you can begin work on the interface board itself. This consists of an electronic switch connected across each key. A 4066 contains four switches so you will not need too many packages. A 4-to-16 decoder is used to operate the switches — the '0' output should not be used. A 4-bit latch is used to hold the data sent by the micro, which means that the micro can do other things while the calculator is processing each key operation. You will also have to arrange some simple address decoding so that the micro can load data into the latch at will. Most printing calculators have a non-add (#) key or a print (P) key. When these keys are pressed they cause the calculator to print out the contents of the display register.

Entering data into the calculator is very easy. The 4-bit word for the first character should be loaded into the latch and must remain for 50 to 150ms; the latch should then be cleared for a similar period before the next key is operated. You have to enter data in

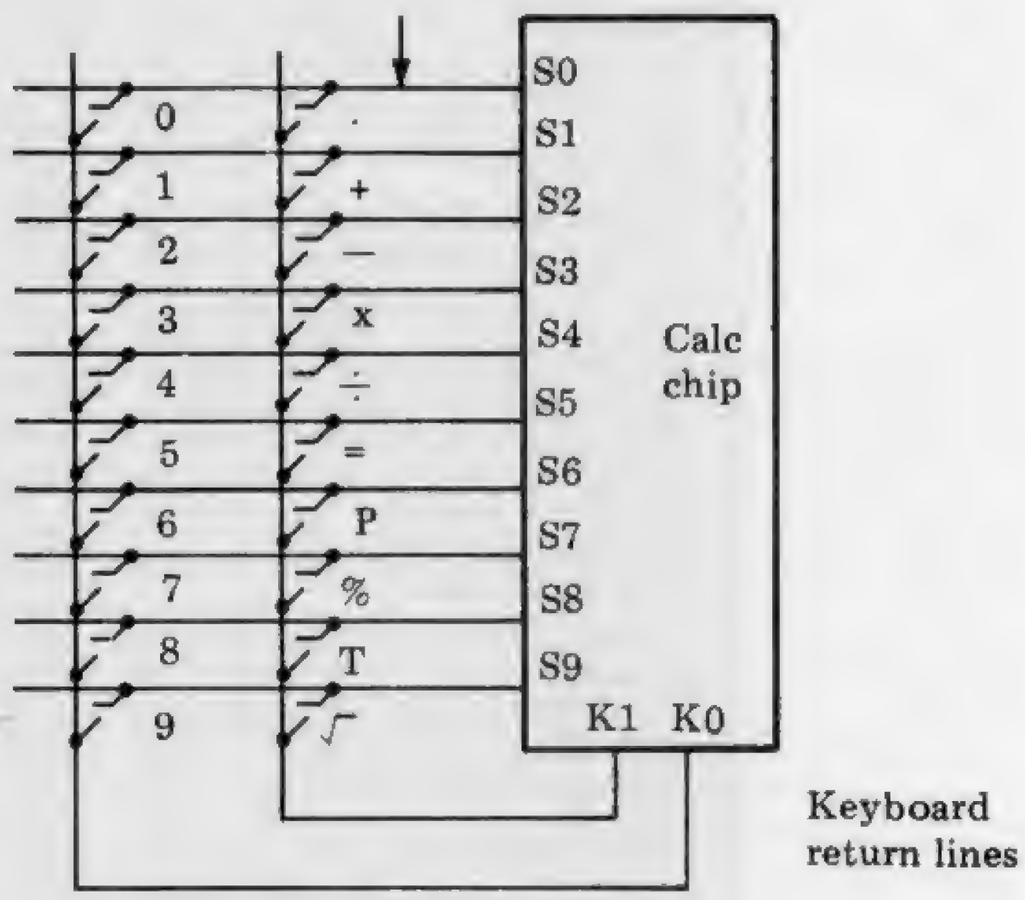

Fig 1 Calculator key matrix

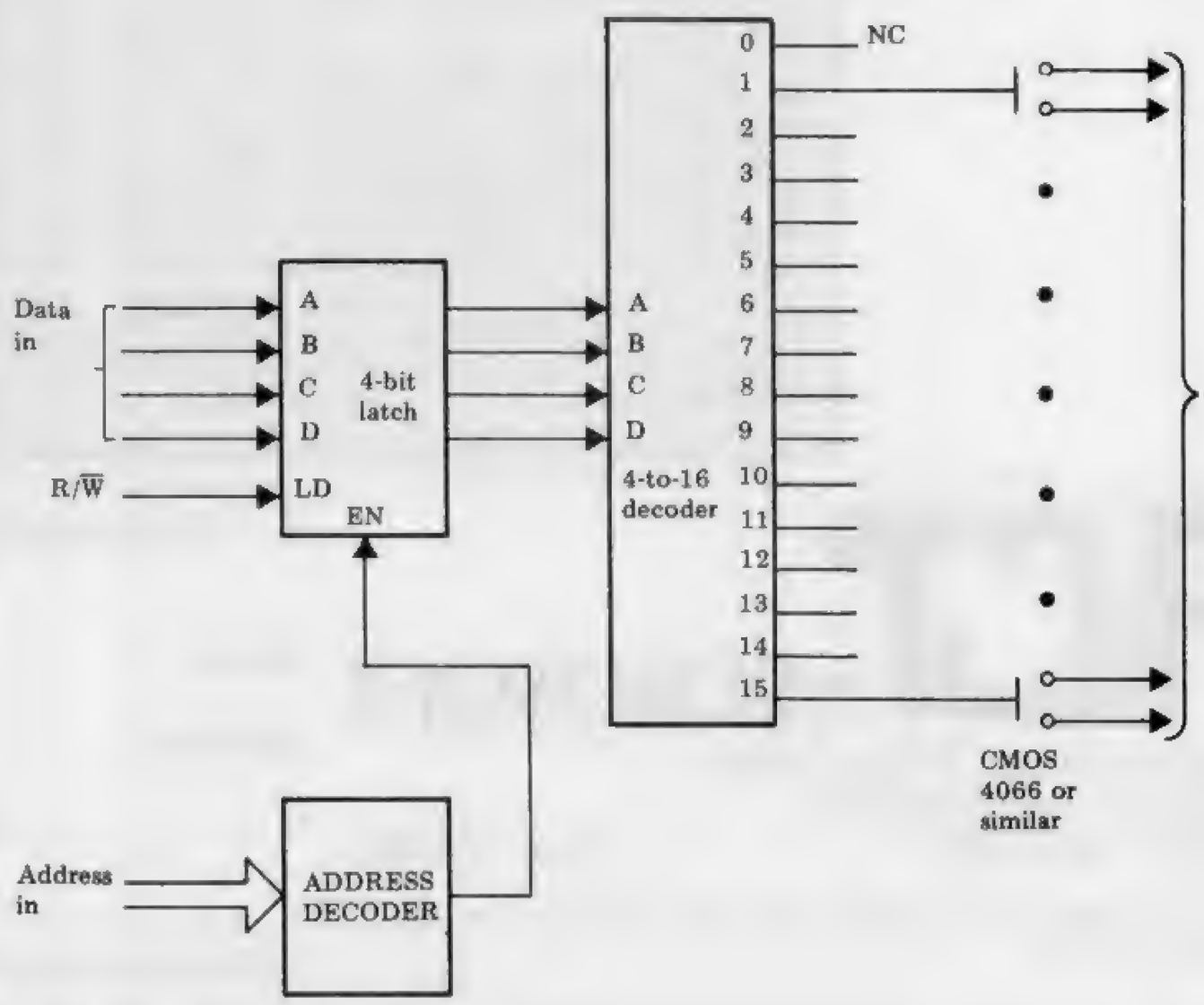

Fig 2 Block diagram of interface system

this way because the calculator chip contains a built-in switch de-bouncing circuit that limits the rate at which you can enter data. By experimenting, you may be able to reduce this time.

When the line of data has been entered, the micro should then operate the print key to print out the line. While this line is printing, you should be able to enter the next line; in fact, most calculators have a five or six line buffer built in which does speed up data entry. This is certainly the cheapest approach if you only wish to use a printer to log numeric data.

If you own a scientific calculator, with or without a printer, you may wish to make use of its accurate calculating abilities, ie, full floating point, 10 or 12-digit accuracy over a range of 10^{-99} to 10^{99}. Again there is a slight snag: in this case, your micro does not have any eyes with which to read the display. This problem can again be overcome by a fairly simple interface circuit. One word of warning, though: if you have a calculator with a liquid crystal display then forget it as trying to encode the drive signals to a multiplexed liquid crystal display is, to put it mildly, very difficult. If your calculator has a LED display, a green fluorescent display or an orange 'panaplex' display then breathe a sigh of relief and read on.

All calculator displays are multiplexed to save connections so unless your machine is very old, you will not be able to get at the BCD data. On modern machines, this generally lives within the chip along with everything else. To get at the data you will have to encode the digit and the segment drive lines. This is not too difficult because 7-segment to BCD converters and 16-line de-multiplexers are readily available. The only problem lies in level shifting between the display and logic. Figure 3 shows how a multiplexed display is driven and this will be found to be common on most calculators although the logic levels may be reversed. The easiest way to encode the display data is for the 7-seg to BCD conversion to be carried out continuously. The micro will load the code for the digit that it wishes to read into a latch. The data held in this latch is then compared with the output of a de-multiplexer that reduces the digit drive signals down to a 4-bit code. When these two words agree, the output of the 7-seg to BCD converter should be read by the micro after a short delay. In this way, the micro can select and read each displayed digit. While the machine is calculating, the display is generally blanked so there should not be any problems with the micro picking up garbage. Figure 4 gives a block diagram of the system; as you can see, it is really quite simple.

As a scientific calculator can be bought these days for next to nothing, it seems sensible to use a calculator to carry out mathematical functions while leaving your micro free to work on higher things. Anyway, I hope that this short article has been of some interest to you; if you have any problems, write to me at *PCW*.

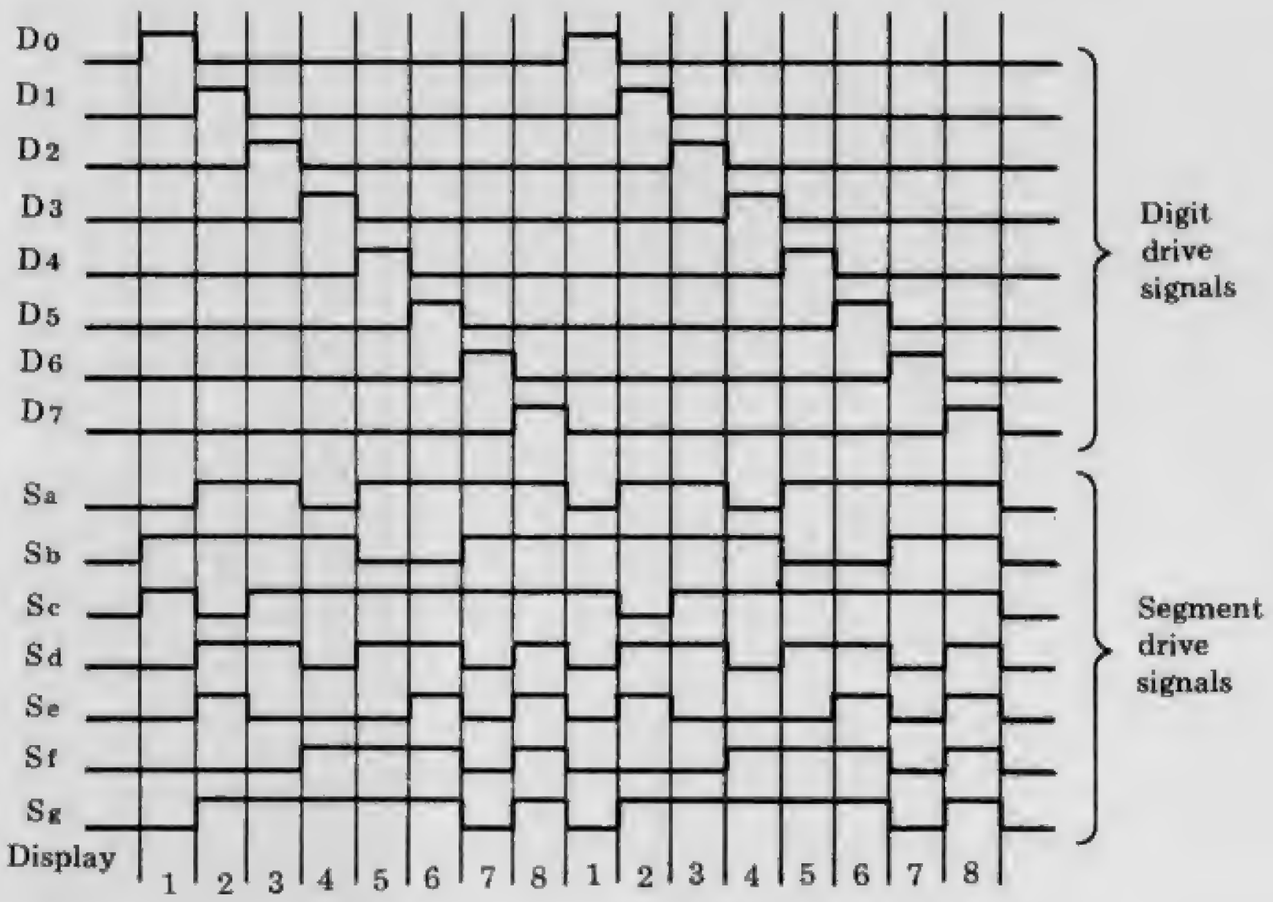

Fig 3 Multiplexed display drive signals

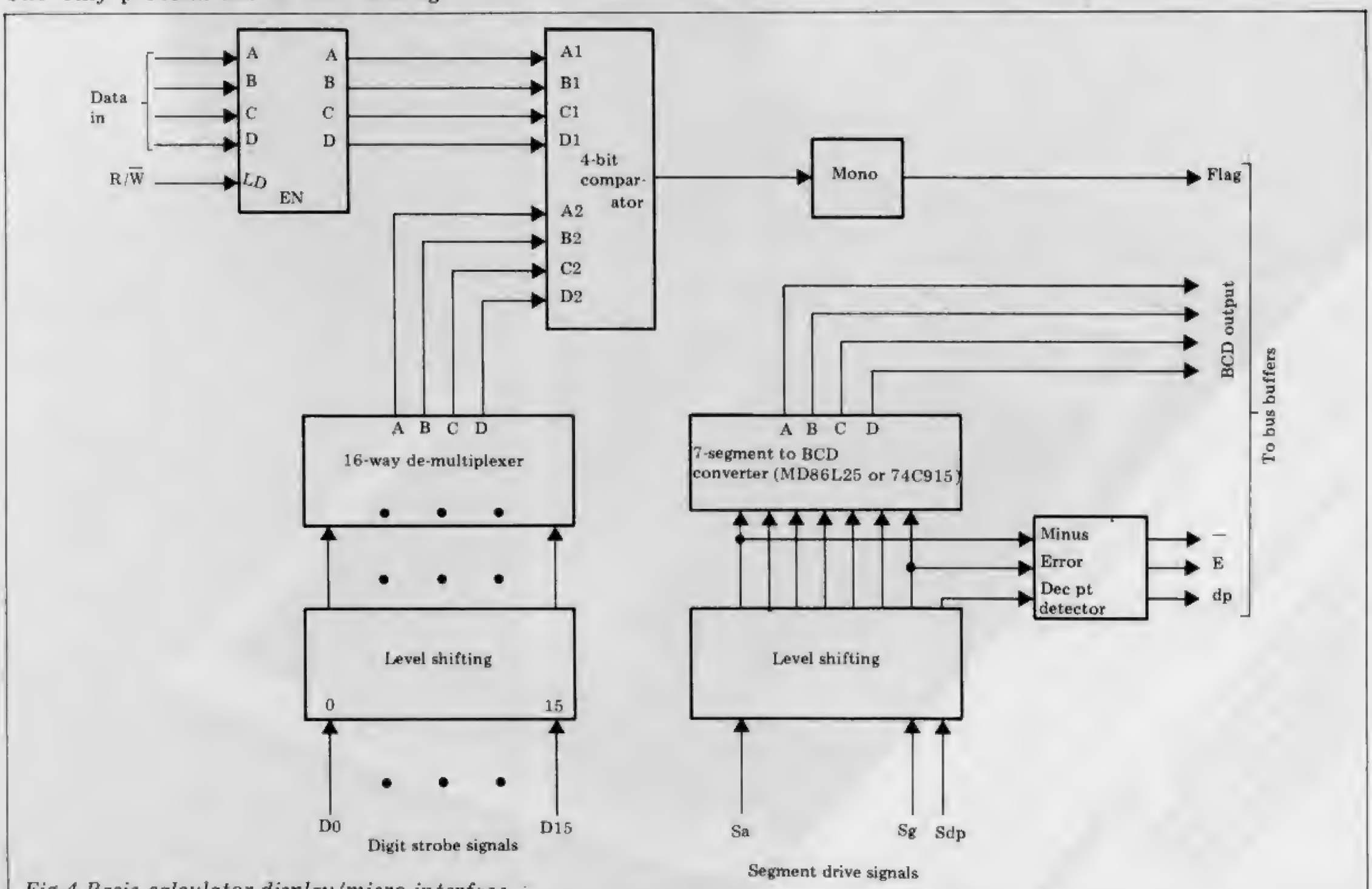

Fig 4 Basic calculator display/micro interface

THE GREAT COVER-UP!

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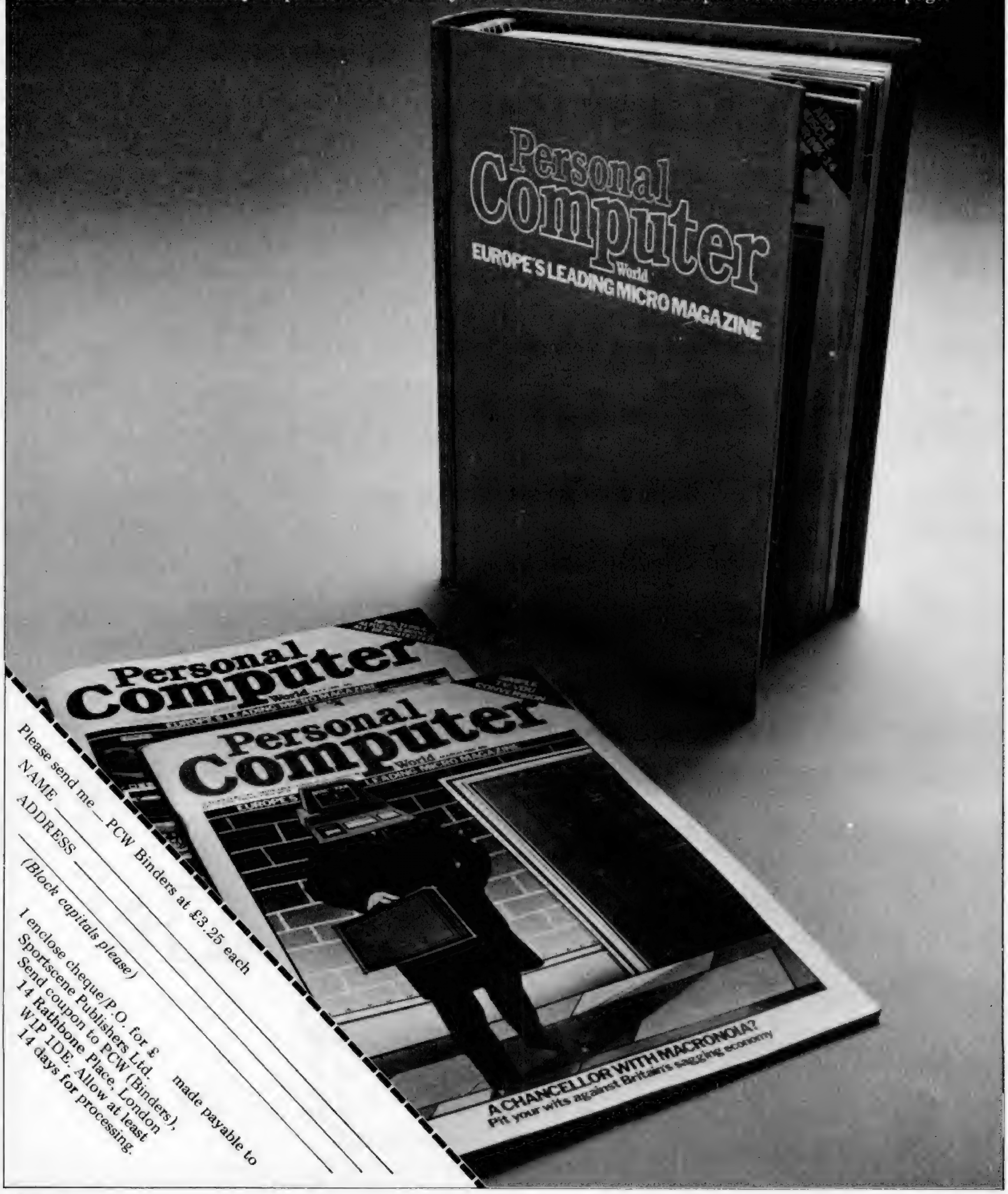

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UP THE SHARP END

Mike Knight of Mike Rose Micros brings another view of life in the real micro world. If you'd like to add your comments, write to: Sharp End, PCW, 14 Rathbone Place, London W1P 1DE.

Illustration by Edward Briant

The problem with micro software theft is that, like tax evasion, many people don't consider it to be theft. In both cases those who gain do so at the expense of the rest of the community. You may gather from the above that this month I'm talking about what we in the trade call 'rip-offs'.

Let's take the simplest example: I know that a large number of you are personal computer users, ie, you don't have to use your computer to earn your living. Most of you will have one of the more popular makes, like PET or TRS-80, supplied with its own cassette unit. The advantage of sticking to the more popular machines is that software is usually plentiful and very cheap. It also means that you are quite likely to find plenty of other local users of the same equipment — and that's where the problem arises. It is just too easy for you to 'share' software. One of you buys a game, someone else buys another and then you go round with your blank cassettes and copy each other's. That way, the two of you have cut the cost by half. Of course, if there are more of you the advantage could be even greater.

'But the game only cost a few pounds,' I hear you say. Well, okay, let's look at how much it cost to produce that game. Most of you will have written at least one program of your own on your computer. How long did it take you to write it? How many lines were there in the program? How complex was it?

Most of the better popular games are likely to be fairly complex, so if you consider that it may take a month to write a program you'll find that the direct costs involved in labour at today's average wage are likely to be over £500. When you add overheads and marketing costs, even the simplest games probably cost over £1000 to produce. At £5 a game, that's over 200 sales needed *before* any profit is made.

If you consider the average business system, the design stage probably takes months and in most cases the complete written system could have taken many man-*years* to produce. Yet here there is an even bigger likelihood of theft. In some cases, the offenders are unscrupulous dealers (thankfully not many) who somehow 'acquire' software and then 'forget' to let the software writers know that they've sold a 'few' copies of it. In other cases it is the users who 'copy' one another's software.

The result of all this is that software producers are building up a large amount of software designed to make theft either very hard or theoretically impossible. Protection is achieved in a number of ways and I'll describe a few of the methods I've used together with others I've seen used.

The first and simplest is what I call the unreadable method. Many software writers, myself included, prefer to use a high-level language because of the productivity advantages it gives. Now while the program is being developed in, say, Basic, you will use lots of remarks and the program will be spaced to ease comprehension. As soon as the development has finished, all the remarks and unnecessary spacing are removed (I even know one friend who has written a 'decomprehension' program). This means that even if a listing of the program is taken, it will take quite a while to unravel it if something goes wrong.

Some programmers include coding in their programs which is just rubbish to confuse any 'poachers' and to identify it subsequently should this become necessary.

Now, staying with high level languages, obviously the methods described above will only hinder the 'thief'. There are two more methods which help to make his task even harder. The first of these is the non-listable program file. In this, the user is supplied with software utilities which allow him to do all security dumps and file prints but will not allow programs to be listed. Now this may not stop the programs being used, but the thief can only use the system as designed for the original user. In addition, provided the user name is displayed regularly throughout the system, it is always obvious that a theft has occurred. I use this method

One of my supplier friends has another method with Basic programs. He has a Basic assembler, in which the Basic program is used as the source for an assembler program which produces a machine-code version of the program. So the advantages in development are kept but the program is made incomprehensible to all but those with assembler knowledge and even then the program is, to all intents, completely protected.

The final methods are, firstly, of course, to write in a low-level language. Some software houses go to great lengths to write assembler code subroutines which can stop programs being used, unless you have a means of copying the operating system as well as the programs. This ability is, of course, only given to those who can be trusted.

Now the net result of all this protection is that a large amount of time and effort is spent doing it. In fact in some cases more care is taken ensuring that programs are 'rip-off proof' than goes into the software in the first place. It is, after all, one deterrent if the program still has a few bugs in it. It's also true that the better the software, the more likely writers are to want to protect it. That means that their costs are going to increase — I estimate by at least 100 percent. If you think that's an exaggeration think how much effort goes into the protection of a program against simple operator errors — it's at least half, and probably more.

All that means that you, the purchaser of software, have to pay more for your programs which, in turn, are likely to be of lesser quality because of the inordinate amount of time we, the producers, are spending protecting our livelihoods against thieves.

Think about it.

PCW *would like to hear whether or not* you *support Mike's point of view. Our own view is that software piracy prevents many good program products ever reaching the market-place. This means that the many potential benefits offered by microcomputers are being denied you and will continue to be so until this tricky problem is resolved.*

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PATTERNS

Alan Sutcliffe continues his series

Arranging tiles into patterns is an ancient pastime. One simple set of tiles, rich in arrangement possibilities, has been used to form the pattern in Figure 1. This can be cut out, pasted onto cardboard and then cut up into the 16 tiles that make up the complete set.

These tiles are oriented — that is, they may not be rotated and they are one-sided, so they cannot be turned over. The edges of each tile are either blank or have a line leading to them from the centre of each tile. With four edges and two possibilities for each, that gives $2^4 = 16$ tiles altogether.

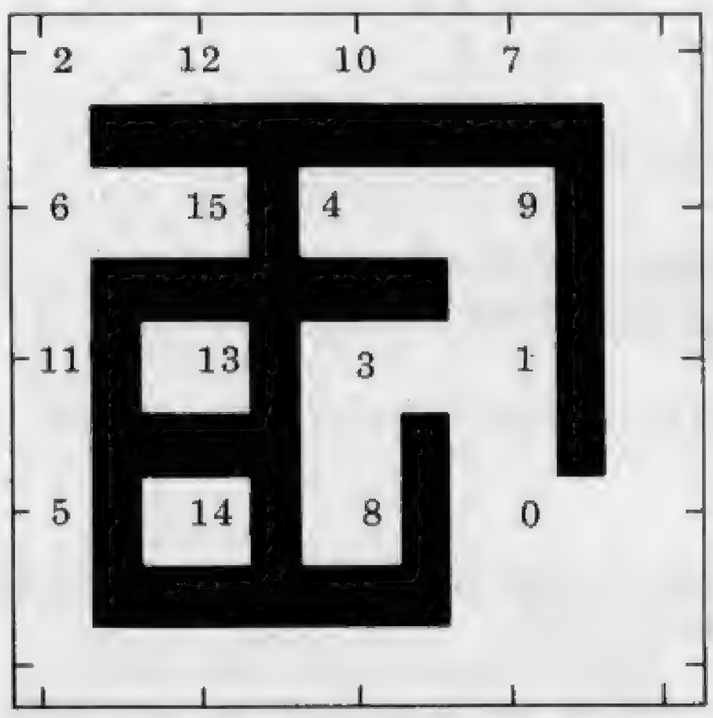

Fig 1 A set of all 16 tiles in an acceptable arrangement. To make a set of tiles, cut out the diagram along the outer frame and paste it to a piece of card. Then cut the card and diagram into 16 tiles using the guide lines on the outer frame. So that the patterns do not match if a tile is rotated the main lines are slightly off-centre on each tile, and the horizontal lines are thicker than the vertical ones.

In an arrangement, every edge with a line must be matched by another edge with a line and no such line may be left unmatched. Any blank edge must either be on the outside of the arrangement or must be alongside another blank edge. Figure 1 shows how these conditions can be satisfied. Tile 0 with no lines can be placed anywhere round the outside of the arrangement, adding nothing of interest, so it will be ignored for the moment and only the remaining 15 tiles considered as the set. These are shown both diagrammatically and in order in Figure 2.

Considering an arrangement in terms of the pattern of the continuous line formed across the tiles, this clearly always has four ends, formed by the terminator tiles 1 to 4. The arrangement of Figure 1 also has two enclosed areas and it can be shown that this is always the case, provided that the line formed is all in one piece. To do this, only the topology of the lines need be considered; their detailed geometry can be ignored.

Group tiles according to the number of unmatched ends. Tiles 1 to 4 have one end each; tiles 5 to 10, the straight-through tiles, have two ends each. Tiles 11 to 14, the T-pieces, have three ends each and, finally, the X-tile 15 has four ends to be matched. To show that any arrangement must have just two enclosed areas, imagine it being built up, starting with the X-piece. There are thus four ends to begin with. As each of the tiles 5 to 10 is added, as they must be in some order, the number of ends is unchanged. As each of the T-tiles 11 to 14 is added, the number of ends is increased by one, since one end is used up but two more appear. That gives eight ends in all. Lastly, as the terminator tiles 1 to 4 are added, each one uses up a free end, leaving four ends unsatisfied. The only way for the arrangement to be completed is for these four ends to be joined in pairs, either directly or through some of the other pieces. This arrangement is unaffected by the order in which the tiles are added. Each pair of ends joined in this way makes an enclosed area, so there must always be two such areas. This is illustrated by Figure 3.

Remember that only the form of the pieces matters here, not the detail, and this proof does not show that an actual arrangement is possible, only that if any is, it has the stated property. The proof would not be changed by the removal of some of the straight-through pieces or by the addition of some extra ones but the number of possible arrangements obviously would be altered. If all the pieces 5 to 10 are removed then no arrangement is possible, but the proof still shows what form they would take if there were any.

If the line across the tiles in a solution is allowed to fall into two or more separate parts, a different number of enclosed areas is necessary, one area for each piece. The proof follows the same lines as the one just given. Figures 4 and 5 show that solutions are possible with the line in two and three parts.

A solution in four sections would have five closed rectangles but there are not enough corner pieces in the set to make this number. Even six areas in five separate sections is topologically possible, as shown in Figure 6, but this would require 18 corner pieces to close the loops.

Fig 7 Array of 3 x 5 cells

As there are 15 pieces to arrange it is natural to ask if they can be fitted into a rectangle of 3x5 cells. No such arrangement is possible. The following proof of this depends on considering the columns in which the various pieces can and cannot be placed, and the numbers of horizontal and vertical ends there may be in each column.

Assume that the cells are arranged in three columns — L, C and R, as shown

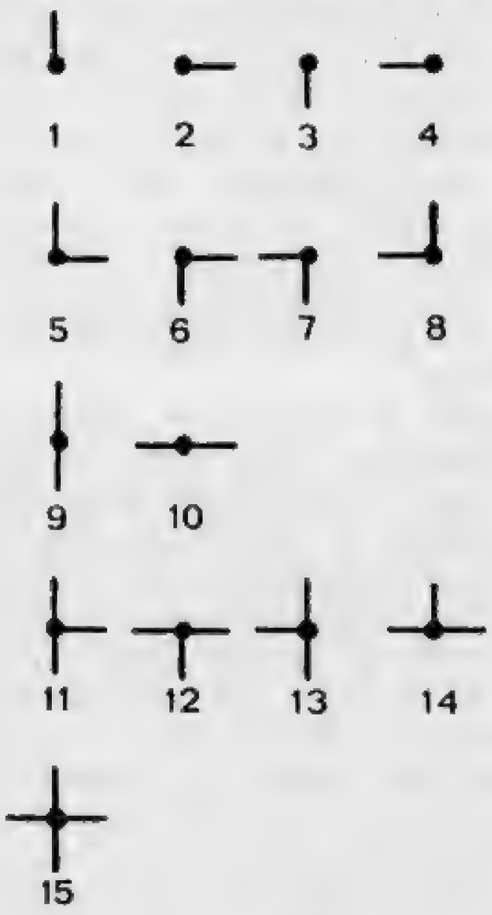

Fig 2 The tiles in order

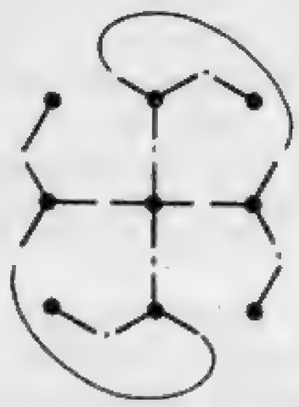

Fig 3 Topology of solutions

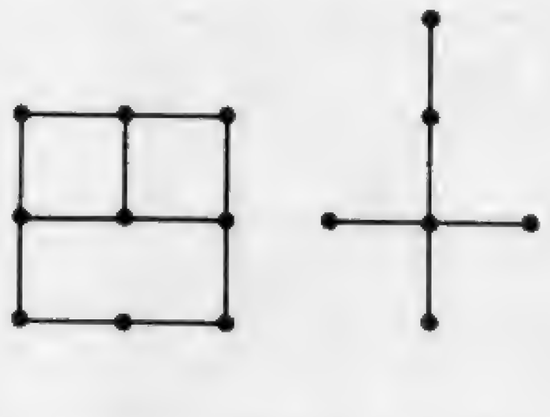

Fig 4 A solution in 2 sections

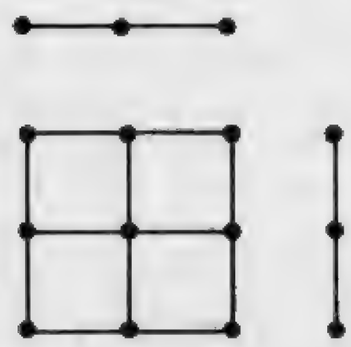

Fig 5 A solution in 3 sections

Fig 6 Topology of a solution in 5 sections

in Figure 7. The four pieces, 10, 12, 14 and 15, group (a), which have ends to be matched at both sides, can only be placed in the centre column, C. Similarly, pieces 2, 5, 6 and 11, group (b), which have a right-hand end to be matched, can only be placed in columns L or C. Pieces 4, 7, 8 and 13, group (c), can only be in columns C or R, while the remaining pieces, 1, 3 and 9, group (d), may be put in any column. This is summarised in Figure 8.

Each horizontal end in the centre column must be matched by a corresponding end in the L or R columns. There are already eight horizontal ends in the four pieces which must be in the centre column, and there are only eight more horizontal ends in the remaining 11 pieces. So the fifth piece to be selected from the 11 to complete the centre column must have no horizontal ends, otherwise there would be more horizontal ends in C than could be matched in L and R. Hence, the fifth piece must be one of group (d).

Now consider the matching of vertical ends. Each column must have an even number of these, since they must match in pairs where they meet. The four pieces of group (a) which must all be in column C, have just four vertical ends. It follows that the fifth piece must have an even number of vertical ends and so must be number 9.

For column L, this leaves the four pieces of group (b) plus 1 or 3.

For column R it leaves the four pieces of group (c) plus 3 or 1.

These alternatives are equivalent by reflection. In either case, we are left with five vertical ends each in columns L and R, and no arrangement is possible with an odd number of vertical ends in a column.

GROUP	PIECE	COLUMN
(a)		C only
(b)		L or C
(c)		C or R
(d)		any

Fig 8 Table of pieces and columns

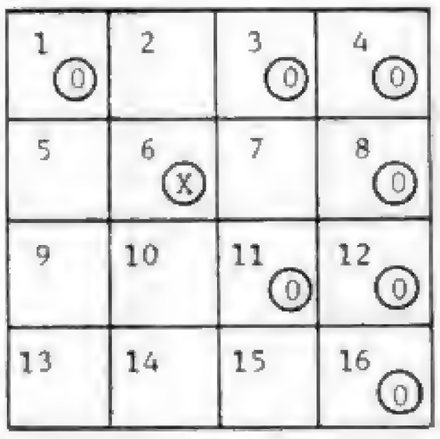

Fig 9 Cell numbering and placing the X and blank tiles.

Now that we know something about arrangements, what kinds do and do not exist, is it possible to start listing all of them? First of all, it must be decided what is meant by 'all of them'. Many solutions, such as the one in Figure 1, have a mirror image. And both of these may have three further versions each by rotation. So that, rather than one solution, there is a set of eight solutions. In addition to these variants not being interesting, it is also a waste of time counting them all separately. Only basic solutions, without their reflections and rotations, are to be counted.

To keep the program and discussion to a manageable size, only solutions which fit all the tiles into a matrix of 4x4 cells are to be enumerated. Tile 1, the blank tile, can always be fitted into the empty cell left when the other 15 tiles have been placed. In what follows, for the sake of convenience in the program, this tile will be known as tile 16.

Rotation can be ruled out by keeping the symmetrical X-tile, number 15, fixed in one cell. Clearly it cannot be in one of the 12 cells round the edge of the matrix but only in one of the four centre cells, and these are equivalent by rotation. Figure 9 shows the numbering of the 16 cells with the X-tile in cell 6.

To rule out mirror images is only slightly more tricky. Consider the axis that runs diagonally across the matrix through the centre of the X-tile. The blank tile 16 must be on this axis, or on one side or the other of it. Only cells on or above the axis need be used for tile 16. In addition, tile 16 cannot be next to the X-tile, so it cannot be in cells 2 or 7. The only cases that need be counted are those with tile 16 in one of cells 1, 3, 4, 8, 11, 12 and 16, as also shown in Figure 9. In fact, the program given here only counts the cases with tile 16 in cell 1. It will be seen below that the other cases can easily be enumerated by resetting the initial data and slightly altering some of the tests.

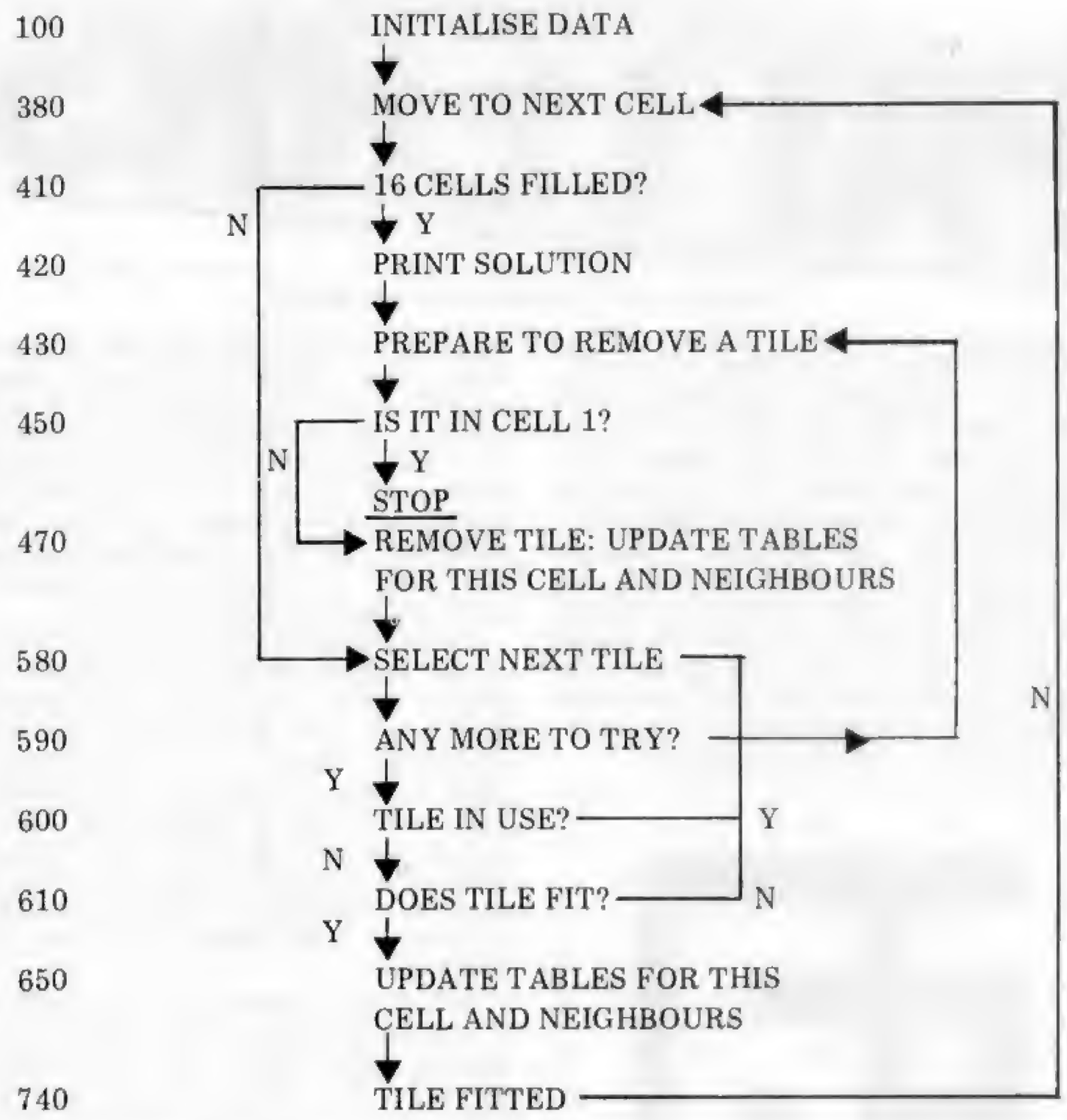

Fig 10 Main steps in the search algorithm

There are at least two ways of counting the arrangements, depending on how the next cell on which a tile is to be placed is selected. The first way is to run through the cells in order as they appear in the matrix. This is easy to program but may entail trying a lot of cases that could simply be ruled out by building slightly more knowledge about the constraints into the program. Alternatively, a record could be kept of the free ends that are currently in the partial solution. For example, there are initially four from the X-tile. Then only pieces which satisfy these ends could be selected, and the solution would be built up as a connected line, rather than in the numerical order of the cells. This difference is similar to that between vector graphics and scan-line graphics. This second, more clever, method needs more programming but takes less machine time. For once, I am going to present the brute force method, and leave the sophisticated one to you. Well, it's not very flattering the other way round.

Figure 10 shows the main steps in the algorithm. You may be surprised that there is no FOR loop. There is one pointer, F, which records the cell currently being dealt with. Which tiles have been used and which are still free is recorded in the data. Each time a new cell is to be filled the free tiles are tried in numerical order. If one is found that fits then the process is repeated for the next cell. If no tile fits then the tile in the preceding cell is removed and the next tile for that cell is tried, and so on. When all 16 tiles have been placed, then a solution has been found. When an

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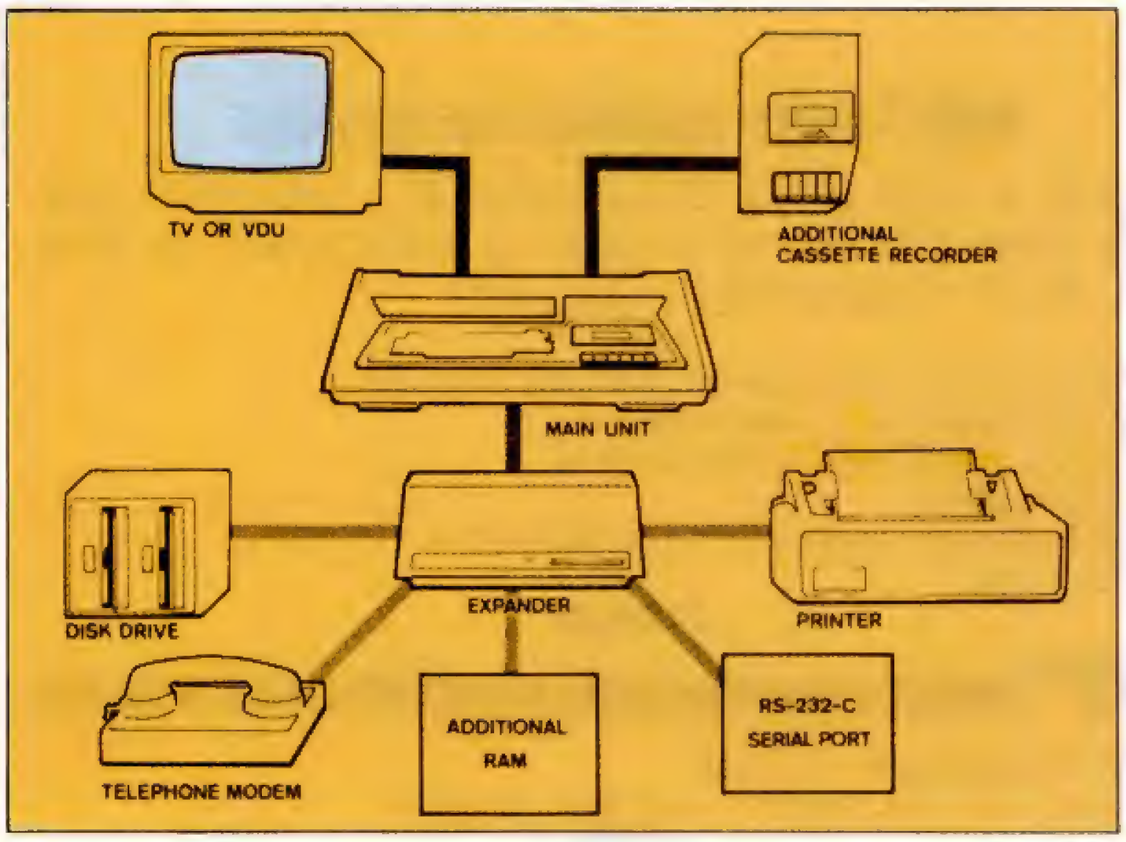

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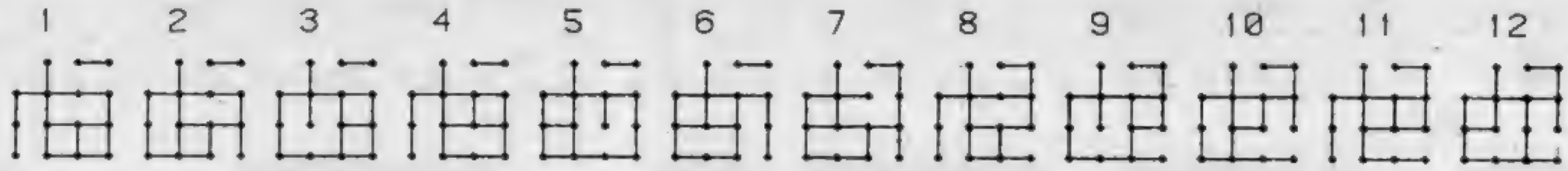


Fig 11 The first 12 solutions

attempt is made to remove the tile in cell 1, then the counting is complete.

As is often the case in solving this kind of problem, the organisation of the data is as important as the logic of the program.

The array T(4,16) describes the 16 tiles, one value for each side of a tile: -1 indicates a blank side; 1 a side with a line to match. These values remain unchanged.

The array C(4,16) gives the values of the sides of the cells which have tiles in them and the values which are required for other sides, either because they are next to an outside edge or because they are next to a tile. -2 indicates an outside edge which must retain its value, even when a tile is removed from this cell, -1 indicates an internal side that must be blank, 0 indicates a side that may have a blank side or a lined side, and 1 indicates a side that must have a lined side.

The array D(16) shows the value of the tile in any occupied cell, and is 0 for unoccupied cells. The same information is also kept in the array S(16) but here the elements represent the tiles in order, not the cells. 1 indicates a tile already in use and 0 one still to be used. D and S are both updated whenever a tile is added or removed. The initial values set in these arrays for the starting position is shown in Table 1. Table 2 shows the arrays U(4) and V(4) which are used in calculating which cells and which sides are neighbours of a given cell, together with the order in which the sides of a cell are dealt with. Table 3 displays the data of Table 1 set out on the matrix of cells.

The code is given as Program A. The statements to set up the initial data have been left out since this can be read from Tables 1 and 2.

The output is shown in Figure 11. I have given this in graphical form although the printed program only gives the output in numerical form. If you have a plotter, then the code to plot the solutions is straightforward.

Next month I shall write more about the arrangement of these tiles and why my method of eliminating symmetrical cases doesn't quite work.

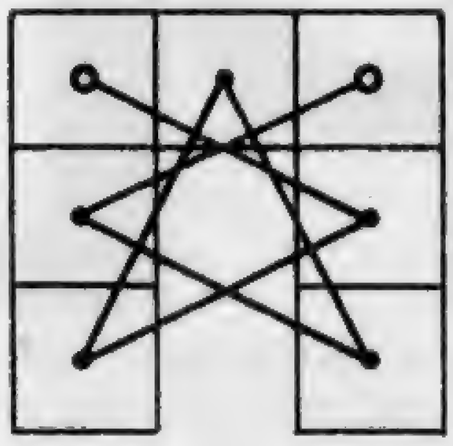


Fig 12 Smallest board for a complete tour of paths

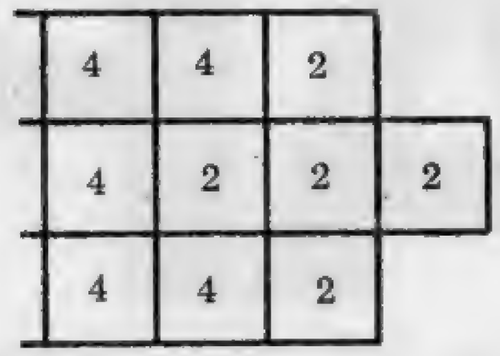


Fig 13 Arrangement of cells at with an even number of paths

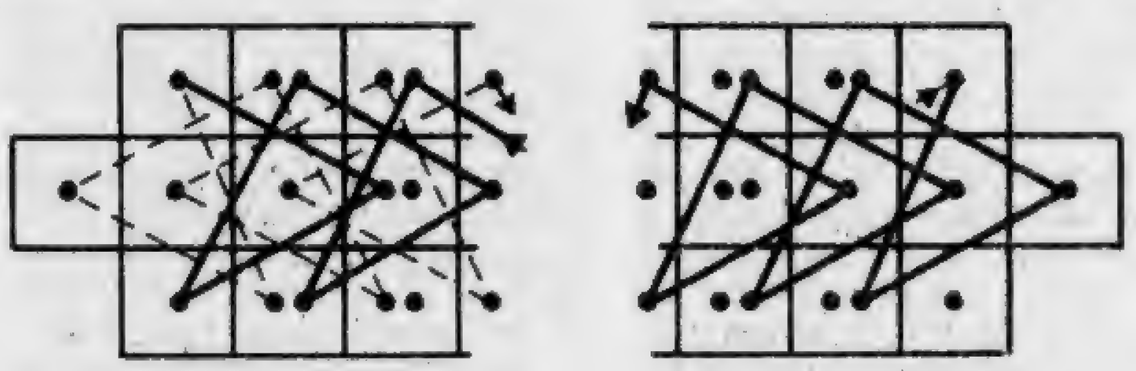


Fig 14 An unlimited solution with three rows of cells.

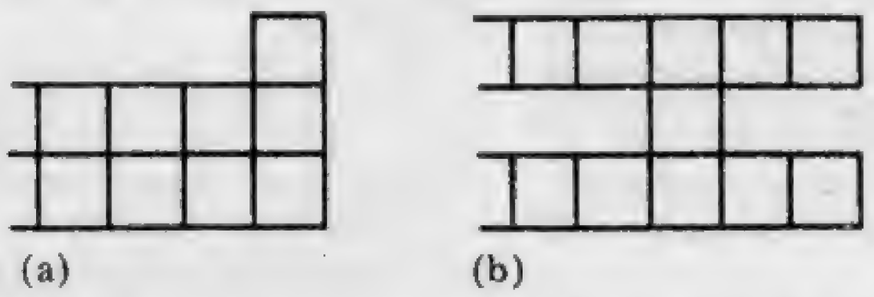


Fig 15 Possible arrangements of two rows of cells.

	T(4,16) Tile data				C(4,16) Cell data				D(16) Tile on cell	S(16) Tiles used
1	-1	-1	-1	1	-2	-1	-1	-2	16	0
2	-1	-1	1	-1	-1	1	0	-2	0	0
3	-1	1	-1	-1	0	0	0	-2	0	0
4	1	-1	-1	-1	0	0	-2	-2	0	0
5	-1	-1	1	1	-2	0	1	-1	0	0
6	-1	1	1	-1	1	1	1	1	15	0
7	1	1	-1	-1	1	0	0	0	0	0
8	1	-1	-1	1	0	0	-2	0	0	0
9	-1	1	-1	1	-2	0	0	0	0	0
10	1	-1	1	-1	0	0	0	1	0	0
11	-1	1	1	1	0	0	0	0	0	0
12	1	1	1	-1	0	0	-2	0	0	0
13	1	1	-1	1	-2	-2	0	0	0	0
14	1	-1	1	1	0	-2	0	0	0	1
15	1	1	1	1	0	-2	0	0	0	1
16	-1	-1	-1	-1	0	-2	-2	0	0	1

Table 1 Tile and cell data — initial values

	U(4) Increment to neighbour cell	V(4) Side number in neighbour cell
1	-1	3
2	4	4
3	1	1
4	-4	2

Order of sides on a cell

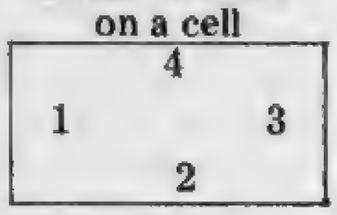


Table 2 Neighbour data

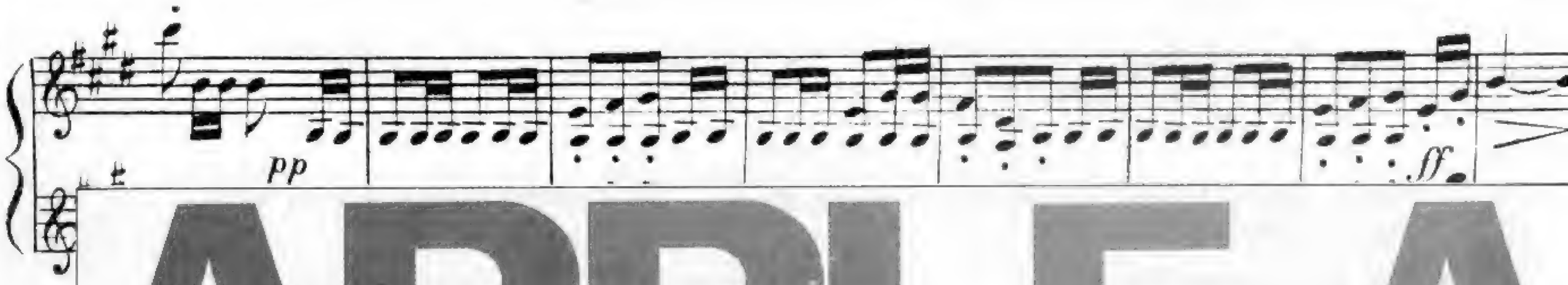
Knight's tours

Last month I wrote about Knight's moves round chessboards of different sizes and shapes. In particular, about tours of a board which are complete not only in visiting every cell, but in passing just once along every possible link between two cells. I asked what is the smallest board, having no isolated island cells and no unused cells surrounded by used ones — inland seas — on which such a tour is possible.

The solution is shown in Figure 12. It is a 3x3 board with one side cell and the centre cell missing: seven cells in all. There is no solution with six or fewer cells.

I also asked what is the largest board on which such a tour can be made. The answer is that there is no largest board, since boards can be constructed of arbitrarily large size. Or, if you prefer to put it another way, the largest board is of infinite size. The trick in finding

GOTO page 145



APPLE A

Don Finlay and Kevin Jones evaluate the hardware and software of two Apple-based ALF music systems. One offers three channels, while the other provides nine channels plus three sound effects.

At any computer show, the Apple demonstration is a big draw, partly because of the colour graphics, but also because of the treble and bass clef music notation which can be seen on the screen if it happens to be showing the music entry system provided by Alf Products of Denver, USA. If the demonstrator then lets the system play a musical item with nine independent parts, the visitor cannot fail to be impressed by the quality of sound produced and intrigued by the unconventional display of horizontally-moving, coloured blips which indicate simultaneously what each part is doing.

I have spent some time studying how this system works and a little time using it, whereas my colleague Dr Kevin Jones has spent considerable time using it. This is a two-part article, therefore, giving our respective technical and musical impressions.

The authors and designers of the package (Rick Harman, John Ridges, Philip Tubb and Forrest Thiessen) must have decided against computer-generated waveforms on the grounds of slow speed, poor signal-to-noise ratio and foldover. Instead, they went for computer control of externally-generated waveforms, in this case, the electronic organ technique of squarewaves, derived from a master oscillator by frequency division. A squarewave can sound reasonable if it has sophisticated control of amplitude, which is provided by computer output to a digital-to-analogue converter volume control that is relatively easy to manage at the lower speeds required for envelopes.

Whereas an electronic organ has, typically, about 100 squarewave generators running continuously, each at a fixed frequency, and with outputs gated in a relatively crude attack and decay circuit, and Alf systems have a maximum of 12 generators in hardware. Each of these is programmable so that it can play any note required, and each has its own DAC volume control. Software limitations and compatibility in fact restrict the maximum used to nine.

The first of the two systems we are reviewing is the MC16 Music Synthesiser. This is supplied as a plug-in board which carries three sound channels, with a maximum of three boards permitted inside the Apple. The current price is £114 per board.

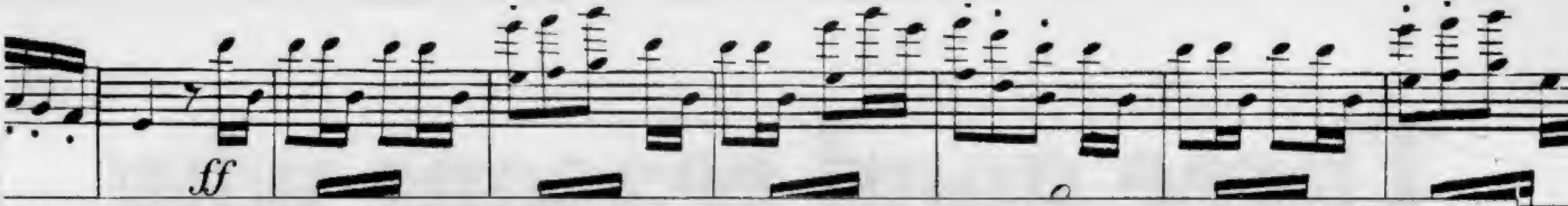
Alf is, I'm sorry to say, not good at explaining how its systems work. The manual contains no specification or description of any sort and no introduction saying: 'This is your music system, and this is what it will do.' So you have to find out its limitations the hard way — ploughing through an instruction manual of well over 100 pages. Just recently, however, Alf produced a leaflet giving some of the information needed and which came to hand as I was writing this report. I have compared the information on the leaflet with predictions from the circuits supplied at the back of the manual — not an easy task as the circuits show only type numbers of the chips, without giving a functional description. This really is not good enough for such an expensive system, apart from making the poor reviewer's life difficult!

The 3-voice board which forms the basis of the system uses a programmable timer chip, the Intel 8253, which contains three independent timers. This is a fairly large chip in a 24-pin package, and is quite conspicuous on the board. It is driven from an on-board crystal-controlled clock oscillator at 1.782 MHz. Each of the timers accepts a 16-bit number in an appropriate register and then counts down. In the particular mode for producing a squarewave from a timer, the output frequency of the waveform is given by the clock frequency divided by the number loaded in, so we can deduce the resolution from this — an important point if we are trying to accurately produce the notes of the equal-tempered scale, or any other tuning, or if we want a *glissando*. To produce 440 Hz, for instance, the divider must be 1782000 divided by 440, which is exactly 4050. If we divided by 4049 or 4051 we would still be within one part in 4050 of the required frequency, which is more than adequate compared with the usual requirement of about 0.1 percent quoted from pitch perception tests.

At the top note of the range provided by software, however, which is G sharp at 6645 Hz, the required divisor works out to 268 plus a fraction. Since we can't use the fraction, we divide by 268 to get 6649 Hz, an error of 4 Hz. Now, musicians prefer to express pitch errors in cents. A semitone, which is a frequency ratio of the 12th root of 2 (a 'half-step') in the equal-tempered scale, is 100 cents, so a cent is 1/1200th root of 2, which works out to 1.000578. The ratio we have is 6649 divided by 6645, or 1.00060, which is clearly a little over 1 cent but is less than 1.5 cents, which is the figure claimed in Alf's leaflet as the maximum tuning inaccuracy, in the highest octave of the MC16.

The crystal also has a tolerance, stated as 0.015 percent, which is about a quarter of a cent. Adjustment of the

The ENTRY program running on the Apple II.

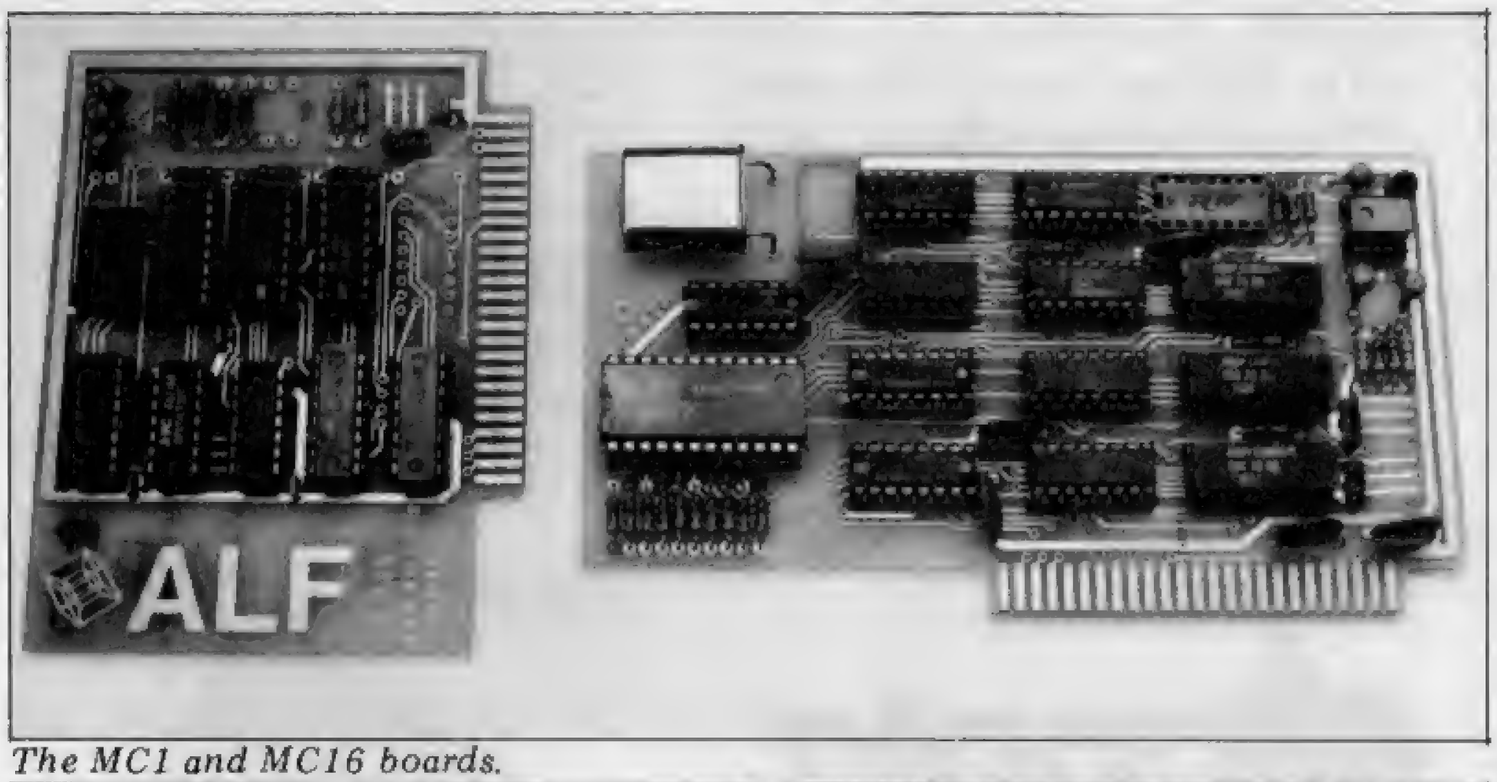


RPEGGIO

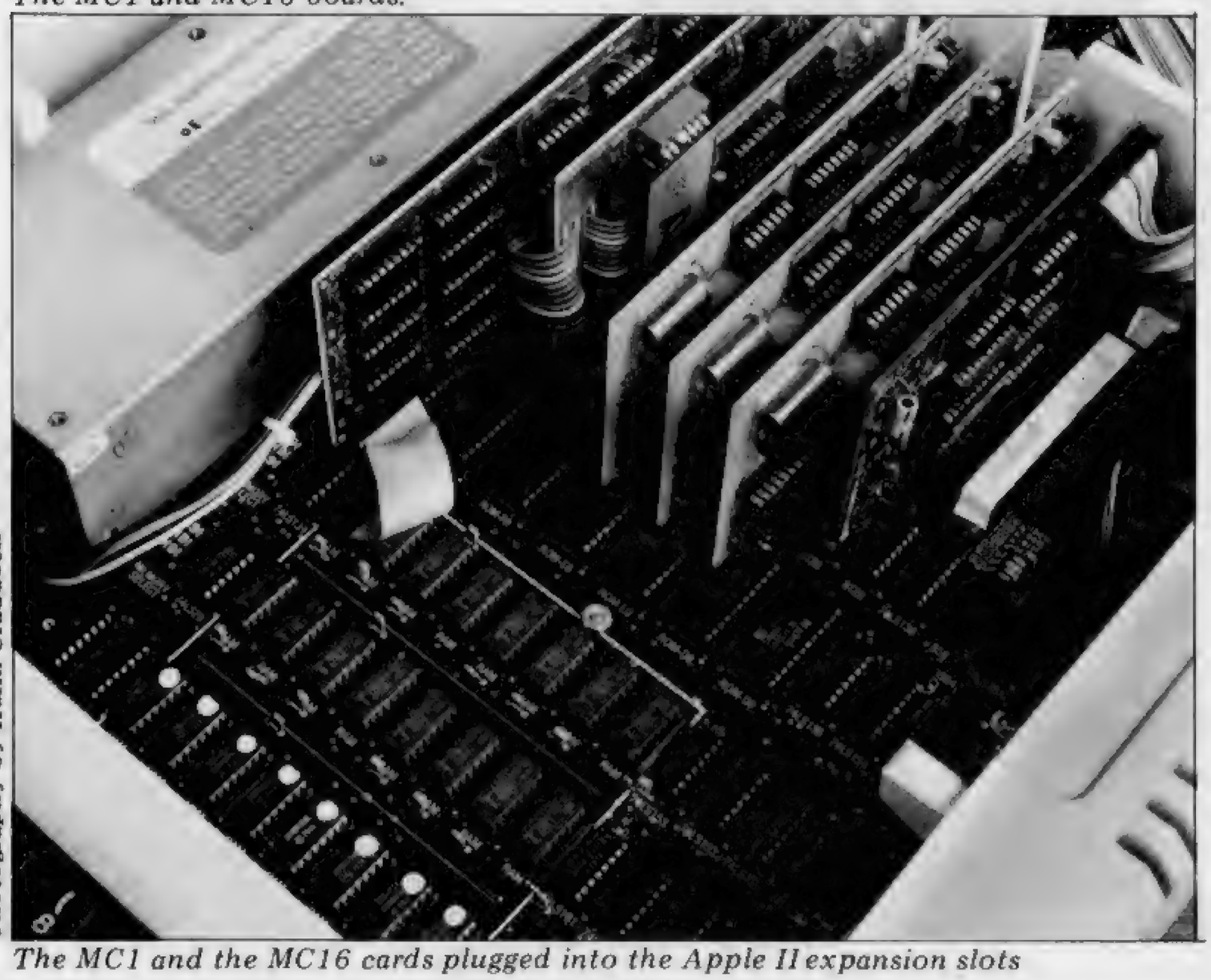
pitch can be made by software, using an OFFSET command. However, this gives only a small adjustment; what it evidently does is add a constant number to each divisor, making the adjustment 'linear' and thereby slightly affecting the tuning ratios.

It is also possible to produce pulse waveforms, by gating one squarewave output from another in each board; this, of course, reduces the number of independent voices from three to two on each board. This is part of the CHROMA routine, a listing for which is given.

Also on the MC16 board are three 8-bit digital-to-analogue converters for volume control of the three voices, giving 256 settings. Normally this 256:1 ratio in a linear converter gives a 48 dB range, but here the range is 78 dB because the chip employed is a 'companding' DAC made by Precision Monolithics Inc to meet a Bell System specification for PCM transmission. In the 8-bit word sent to the DAC, three bits are used to give the logarithmic shape in a piecewise linear approximation, four further bits give linear segments, and the remaining one gives the sign. The seven amplitude bits give a normalised output range from 2 to 8031, which is a 72 dB range; feeding the sign bit from the squarewave timer output effectively doubles this, giving 78 dB.



The MC1 and MC16 boards.



Photography by Karin Craddock

The MC1 and the MC16 cards plugged into the Apple II expansion slots

MC1: The low-cost version

The second system gets the same functions, and more, onto one board which is priced at £91. We find no timer chip but four 76489s driven from the Apple Q3 system clock at 2.046 MHz. These 16-pin chips turn out to be much more complex than their size implies, being 'sound generator' chips of the type made for TV games circuits. Each contains three programmable dividers, operating on similar principles to those in the MC16, and three programmable attenuators; but each also contains a noise generator (feedback shift register type) which can be used for wind and percussive sounds, etc.

Naturally, sacrifices have to be made to achieve so much in so little. Firstly, the frequencies are obtained by dividing the clock by 32 first, giving an effective reference frequency of 63.9 kHz. The divider ratios applied to this are now ten bits, giving a maximum of 1023 instead of the 16 bits of the MC16 which can give 65535. The effect of this is again worst at the highest frequencies, where the divisor is smaller; to get the highest note allowed by software, in this case 4186 Hz, needs a divisor of only 15, with resolution some 260 times poorer than previously. The claimed worst case is 33 cents in the highest octave, which is noticeable. The resolution improves as the pitch is reduced, of course.

The other sacrifice is in the attenuator DAC, which uses only four bits, each controlling binary-weighted attenuator sections of 2, 4, 8, and 16 dB, and giving a claimed maximum of 28 dB when all are used. (Strange — my arithmetic makes the total 30 dB, not 28. Has Alf not picked up the error in the Texas data sheet?)

The chip includes eight registers which contain information for the frequency and volume of each of the three squarewave channels; the noise mode, ie, rate of clocking the feedback shift register; and the noise channel attenuation. Updating the frequency requires a 2-byte transfer, and updating noise or any attenuator requires only one byte. As with the MC 16, sound production is continuous between updates.

One notices that the MC1 board actually contains 12 squarewave generators and four noise generators, although only nine and one are used respectively.

Connection of the boards to the external audio system allows stereo in all cases except where only one MC16 is used, in which case the three outputs cannot be separated. This is not true stereo, of course, only the feeding of a

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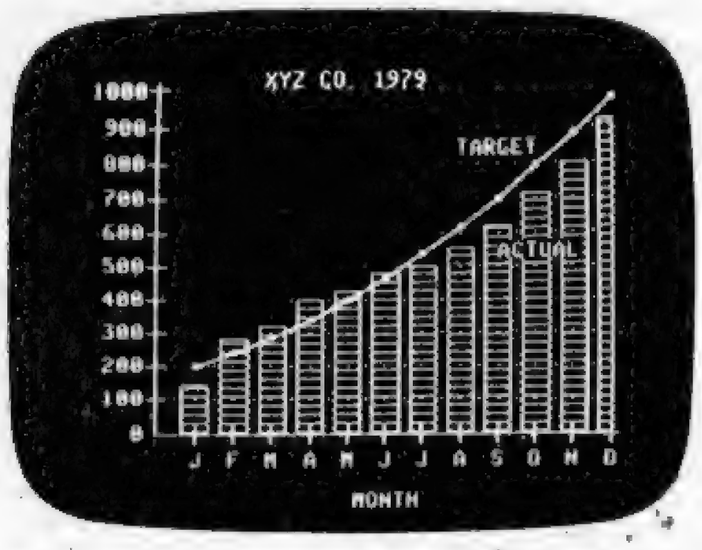

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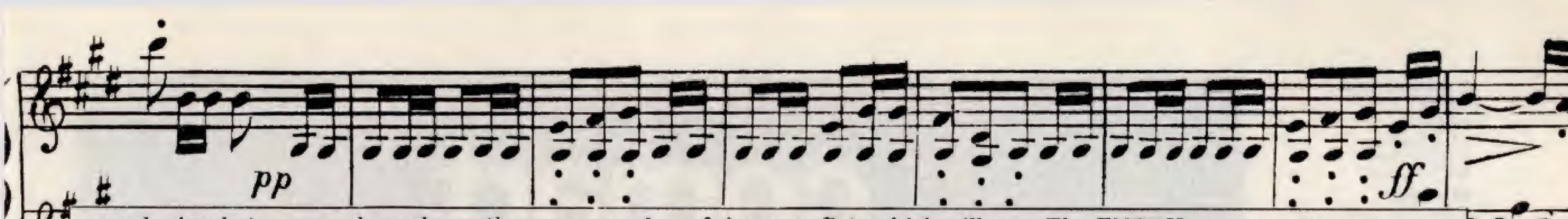

sound signal to one channel or the other, or equally to both.

Summing up, the better system using three MC16 boards costs over three times as much as the single-board MC1, giving better resolution of both frequency and output level in each of nine sound channels, although the single-board one has a noise generator as well. Some ready-made software is available for ear-training skills, ie, in pitch discrimination, intervals, chords and scales, which is available for the 3-board system only, and a number of albums of 'songs' on disk or cassette for both systems.

The system in use

The Alf music synthesiser cards can be plugged straight into an Apple computer, connected up to amplifier and speakers, and are ready to use. They certainly add a whole new dimension to the machine, and have proved to be very useful in the music department at The City University, where the system has been working for nearly a year now.

The cards consist of squarewave oscillators with variable pitch and volume. Sophisticated software comes with the system to provide a powerful range of programming possibilities.

There are two cards available. The older but more accurate MC16 provides three voices and up to three of these cards may be used together. The newer MC1 has nine voices and the possibility of three channels of white noise (for percussion-like sounds) all on the card, but it makes certain sacrifices in accuracy and precision. There are a few other differences which will be mentioned as we proceed.

The most useful aspect of the package is the remarkable ENTRY program which enables notes to be entered as data, using the Apple game paddles interacting with appropriate screen graphics. On running, the image shown in Figure 1 is displayed.

By turning one paddle knob, the little arrow can be made to move along the menu of symbols at the bottom. Having arrived at the desired note length or option, it is selected by pressing the paddle button. A small square lights up below the symbol to help keep track of what is being done.

The pitch of the note is picked out by turning the knob on the other paddle. This sweeps a little flying saucer symbol up and down the musical stave. When the required pitch has been located, pressing the button on the same paddle will write the note on the stave with the note length previously selected from the menu, as in Figure 2. It will also be played through the loudspeakers, which adds an aural check. All very good for the ear.

As the note sequence is built up, the program automatically puts the bar lines in the correct place according to the specified time signature. Tnis is 4/4 by default, but can easily be changed as required by typing in from the Apple keyboard. Figure 3, for example, shows a familiar tune in 6/8.

Likewise any key may be specified as a number of sharps or flats which will straight away be appropriately displayed as a key signature. All affected notes are automatically adjusted for playback.

The menu gives an adequate range of time values, rests, sharps, flats and naturals. Triplets are also catered for, Figure 4 shows that quite complex lines can be entered.

The symbol menu is also used to carry out editing. It is possible to backtrack, move forward, replace, insert or delete notes as required.

The Apple keyboard is used to enter additional information to change the volume or enevelope settings for a sound. The *envelope shape* of a note defines the way in which the note builds up to its peak volume and dies away again. This is very important in giving a note a characteristic sound quality, for example, to determine whether it sounds more like a harpsichord or a piano accordion.

The ENTRY program allows the user to specify an A D S R (Attack — Decay — Sustain — Release) envelope for each note. Regrettably, the section of the manual dealing with envelope shaping is not exactly the model of clarity. I can't resist a temptation to quote from it: 'The current loudness can increase by an amount less than or equal to the "current decay" setting. (Not to be confused with the "decay setting".) In this fashion, it will arrive at the loudness as quickly as the attack/current decay settings permit.

'Once the current loudness collides with the desired loudness the desired loudness spontaneously changes to a new value called the "current sustain level" (not to be confused with the "sustain setting"). Probability states that the new desired loudness may be different than the current loudness (although the current loudness is equal to the old desired loudness), so the

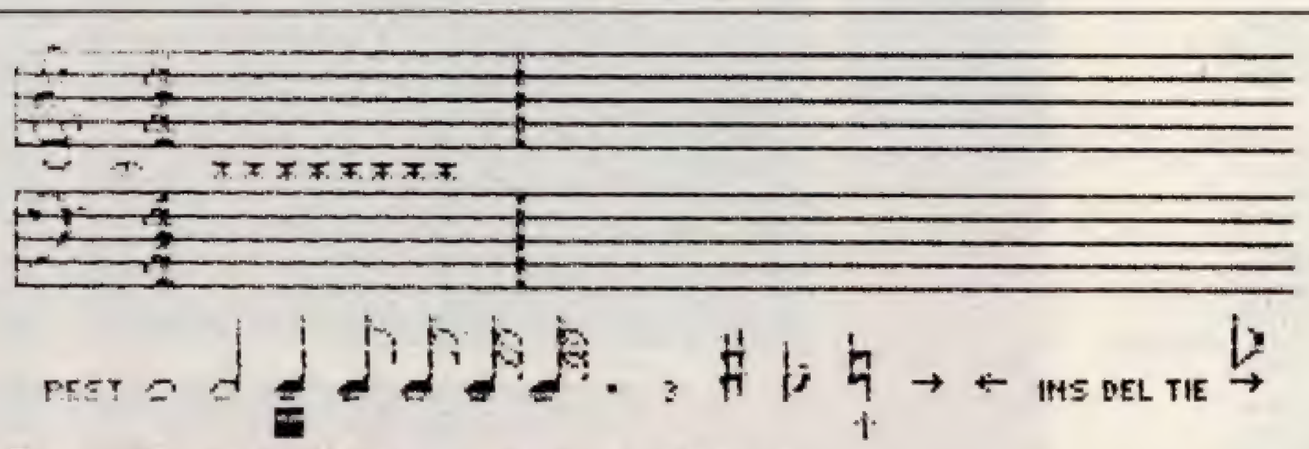

Fig 1 The initial display on running ENTRY

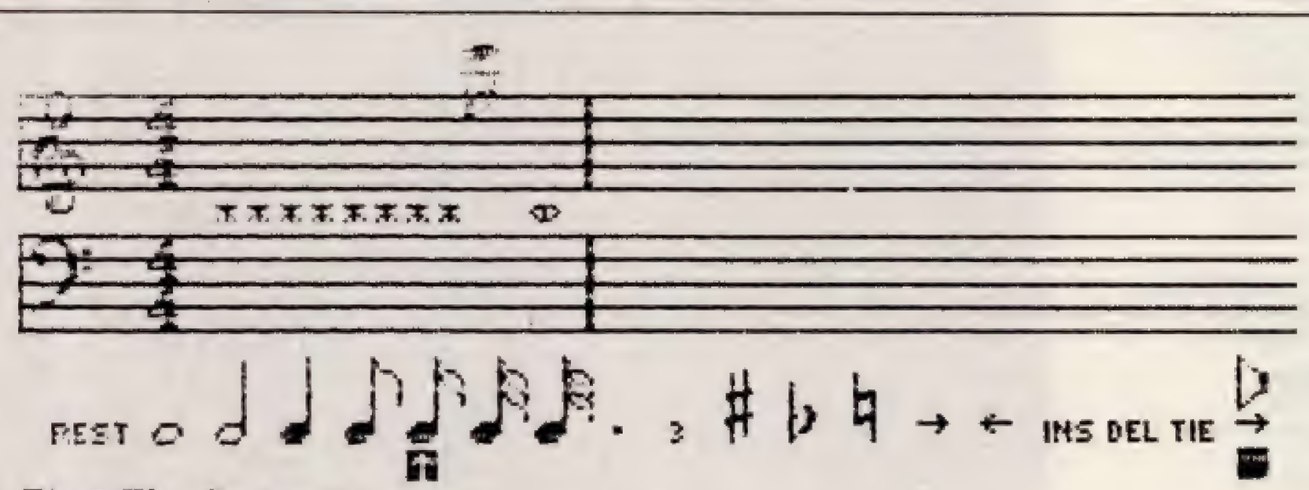

Fig 2 The first note

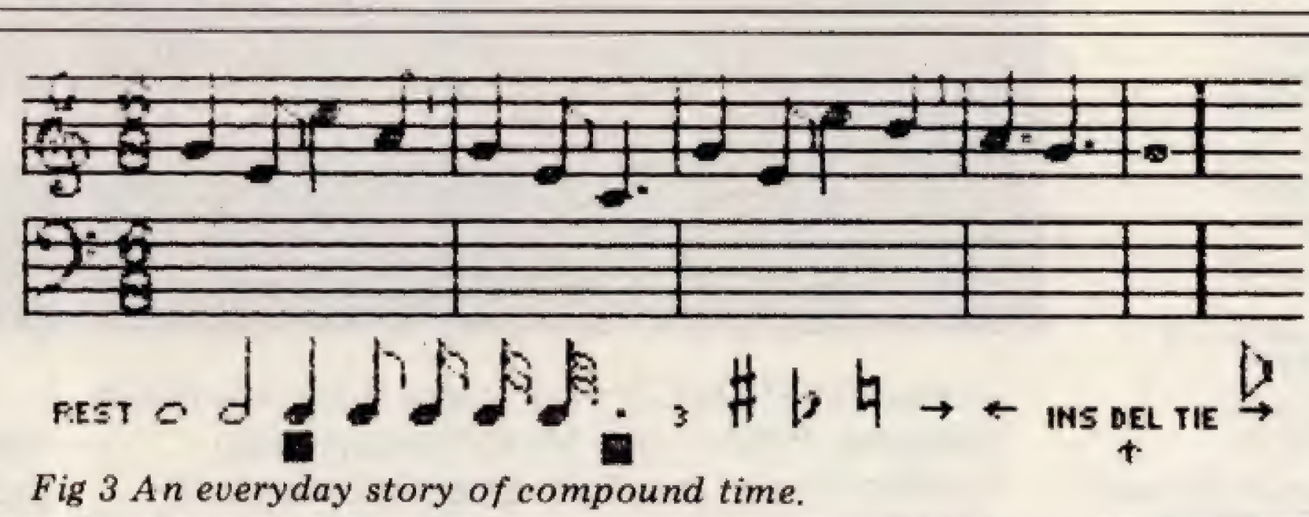

Fig 3 An everyday story of compound time.

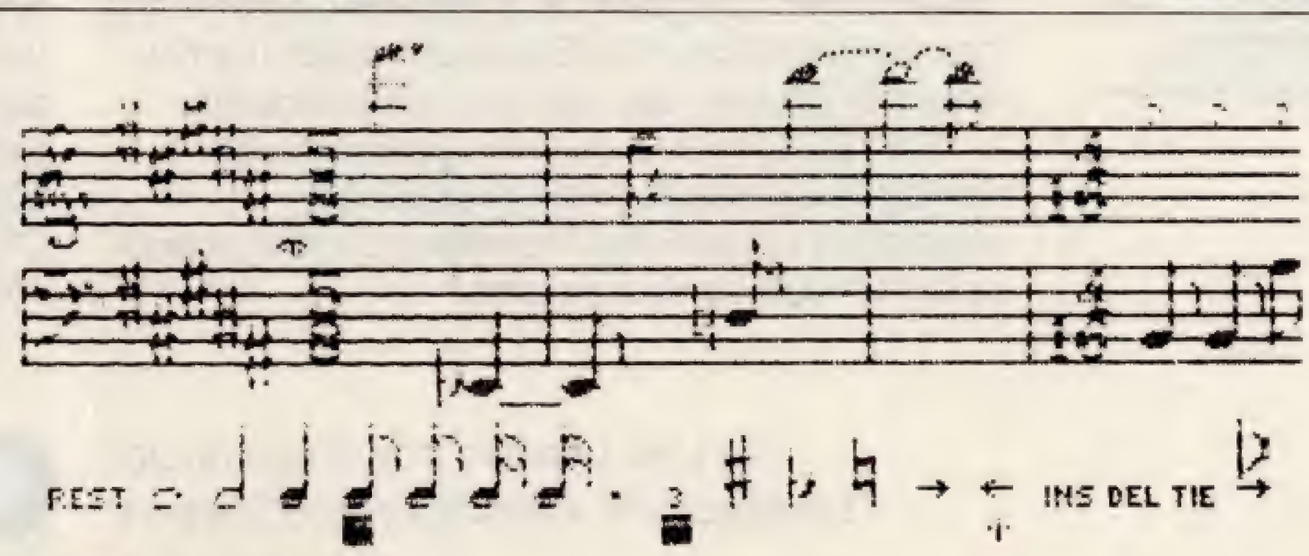

Fig 4 Uncommon time.

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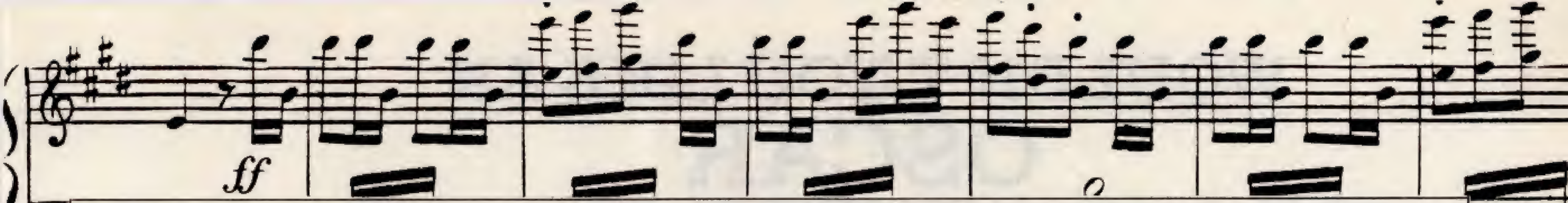


current loudness must again seek the desired loudness. This astounding natural process continues at all times during playback. The current loudness cannot be affected directly, so it must be "guided" by selecting appropriate parameter settings.

Notetrinos generated using a high-power paramatron at the University of Northern South Dakota (just across the border from Hoople) have revealed the following characteristics of these settings. When a new note begins, the most recent decay setting is written into the "current decay" rate. . .'

And so it continues. I wonder what a 'paramatron' is? Shades of an Oedipus complex perhaps?

But to return to the Apple synthesisers. Fortunately, a set of default envelope settings is built into the ENTRY program which allows the user to start putting in notes immediately. After a little practice, this can be done quite quickly. When the first voice (PART 0) has been completed, subsequent parts can be entered in the same way.

At any time it is possible to play back the work in progress simply by typing PLAY. When this is done, or when any stored composition is being played, the screen changes to a different display. It is not possible to represent up to nine independently moving parts in traditional notation, so an ingenious alternative has been used.

A horizontal line corresponds to each part or voice, with the pitch range stretching from left to right; low to high, just as on a piano keyboard. As the pitches change, a little square sweeps backwards and forwards, following the notes up and down like a magic hand on an invisible keyboard. The colour of the square changes according to the note's intensity. With all nine parts going simultaneously, the result is like some mighty automatic Wurlitzer console in action.

A central white square on each line shows the position of Middle C. If notes need to go higher than space allows, 'Middle C' shoots to the left to make room. Similarly it shifts to the right for very low notes. Figure 5 shows a moment from a typical display, quite an attractive representation, which clearly shows the shape of the sounds being heard.

During playback, the speed can be altered as desired with one of the game paddles. The more parts there are, the slower the whole thing becomes, and the less speed variation is possible. One rather annoying habit of the system has become apparent in this respect. If the number of parts is reduced in the middle of a piece, for example, by having rests in certain voices, everything speeds up. When the resting voices come back in, it slows down again. This is difficult to avoid. Either voices need to be doubled up, or else resting voices have to be given dummy parts to play at a silent volume level.

Once a composition has been entered, it can be saved on disk (or tape) and subsequently recalled at any time for further editing or to be played.

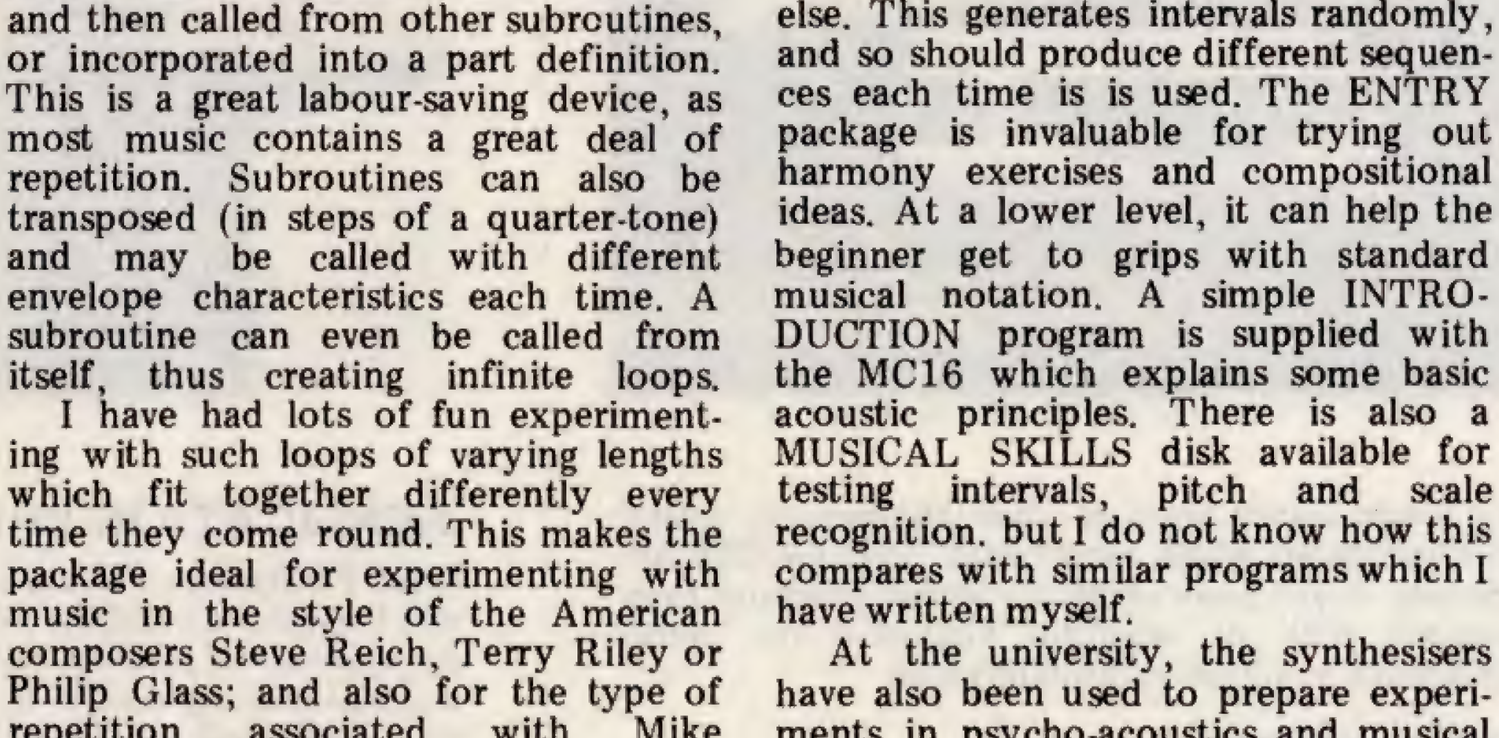


Fig 5 A moment from a typical playback display, with five voices being used.

A very useful aspect of the package is the *subroutine* facility. Strings of notes can be defined as subroutines and then called from other subroutines, or incorporated into a part definition. This is a great labour-saving device, as most music contains a great deal of repetition. Subroutines can also be transposed (in steps of a quarter-tone) and may be called with different envelope characteristics each time. A subroutine can even be called from itself, thus creating infinite loops.

I have had lots of fun experimenting with such loops of varying lengths which fit together differently every time they come round. This makes the package ideal for experimenting with music in the style of the American composers Steve Reich, Terry Riley or Philip Glass; and also for the type of repetition associated with Mike Oldfield's music.

The synthesisers on their own are not really sufficient for any sort of commercial musical use, for the square waves soon become very tiring on the ear. But by using filtering and other studio treatments, there is no reason why the sounds should not be made more interesting.

With the MC16 board, there is the possibility of *pulse-width* modulation to vary the square-wave sound. This facility is not available with the ENTRY package but can be programmed in Basic, making use of a set of assembly-language routines called CHROMA.

The Basic programming option opens up a wide field for more serious research and for the generation of new, lively timbres. I have made a few experimments using *stochastic* techniques (where probabilities are used to make choices) to control very fast changes in a sound's specification. This has produced some interesting results.

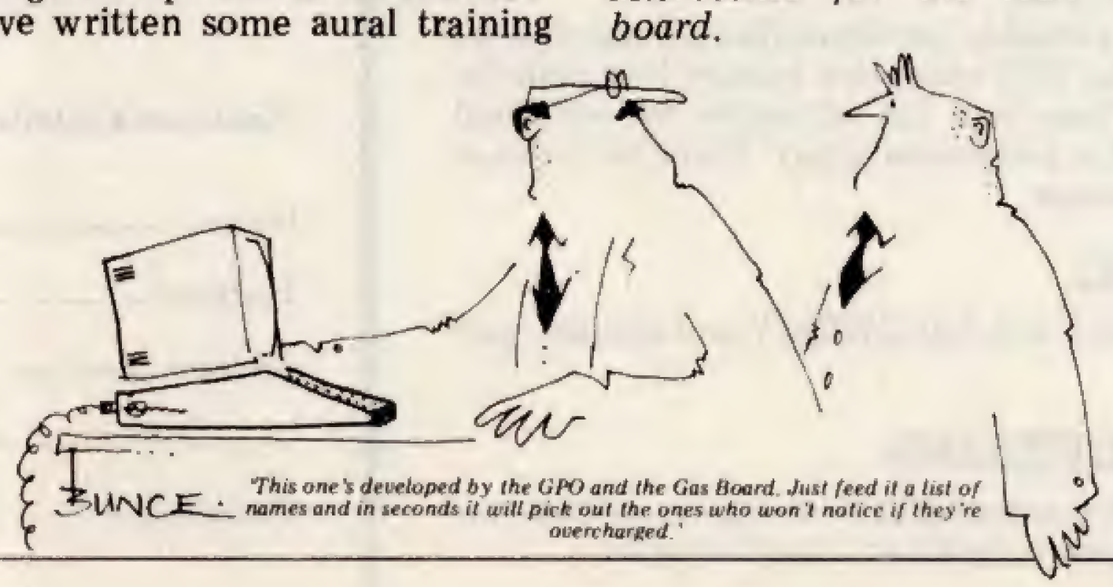
These synthesisers, then, have a wide range of application. In The City University music department they have already begun to prove useful in teaching. I have written some aural training programs which enable a user to test himself alone, without the embarrassment of flunking in front of anyone else. This generates intervals randomly, and so should produce different sequences each time is is used. The ENTRY package is invaluable for trying out harmony exercises and compositional ideas. At a lower level, it can help the beginner get to grips with standard musical notation. A simple INTRODUCTION program is supplied with the MC16 which explains some basic acoustic principles. There is also a MUSICAL SKILLS disk available for testing intervals, pitch and scale recognition. but I do not know how this compares with similar programs which I have written myself.

At the university, the synthesisers have also been used to prepare experiments in psycho-acoustics and musical perception. It is possible to define particular sounds very precisely and exercise fine control over such aspects as speed of playback.

In conclusion, the Apple Alf music synthesisers represent an invaluable addition to the Apple family of accessories. After many months of using the software it seems, amazingly, to be quite free from bugs. Unfortunately, the documentation is, in general, rather muddled and could be quite a problem for anyone new to the microcomputer scene. This is a pity in a package which is obviously designed to be self-contained. I also find the general patronising style of such Transatlantic manuals a little off-putting ('Isn't this exciting?'). But perhaps that is just the view of an insipid Englishman.

I reckon it represents good value for money. Enterprising music departments might consider it worth buying a complete Apple package for the sake of the synthesisers and accompanying software alone.

Acknowledgement: our thanks to Microsense for the loan of an MC1 board.



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We were intrigued to be offered an opportunity to review an implementation of the MVT Famos operating system — billed as a system 'without peer in design and operating efficiency'; multi-tasking and multi-user with 'no significant degradation in response, even with several concurrent terminals'; and with a Basic compiler 'well suited to every conceivable application.' These seemed pretty strong claims which, if justified, would go a long way to solving a lot of peoples' computing probblems. Now read on. . .

Hardware

MVT Famos was supplied on an Industrial Micro System 8000. This machine is a Z80A S100 system with two 8in double density, single sided drives, 64k RAM and four serial ports. We also used Famos on Microtek Computer Services' development system. Its Z80A S100 system had 192k of RAM and 18 Mbyte of hard disk space. The documentation states that Famos requires disks, an 8080 (or 8085 or Z80) processor with a CP/M bootstrap in ROM, 32k RAM for Famos and 32k for each additional user. There are no inherent restrictions on the number of users which a Famos system can support although, in practical terms, the particular application will determine both the degradation experienced and the acceptable upper limit.

Efficient disk access is essential as all the system functions and utilities are stored on the disk and normal operation engenders a great deal of traffic — hard disks, therefore, are a distinct advantage. All terminal communication with the operating system must occur in upper case so sanity demands either an upper case terminal or a terminal featuring a 'caps lock' or similar switch. (Anyone who thinks that a simple shift-lock will do has not counted the number of times that '.' or ',' or simple digits are required in normal programming.) The word processor Wordflow requires 'clear screen' and an addressable cursor and is most easily used if 'clear to end of line', 'clear to end of screen', 'delete line' and 'insert line' are implemented also.

Famos seems to offer software to support a fair range of disk-controllers including Industrial Microsystems 8000, Tarbell and iCom floppies; and MITS 88, xCom and Calcomp hard-disks. Support here includes formatting functions and a range of interleaving options.

The documentation claims that Famos uses a number of microprocessor facilities which are not exploited by other operating systems (all eight interrupt levels on the 8080, for instance), so that hardware which runs other systems quite happily may crash under Famos because some such facility has never been fully tested. The documentation, further states that it is the user's responsibility to ensure the integrity and reliability of the hardware before using Famos. We take this to imply that Famos itself does very little automatic checking during operation, although there are a number of stand-alone diagnostics for checking both memory and disks.

The operation system

MVT Famos is a multi-tasking, multi-user operating system offering the usual four features, namely: dynamic allocation/scheduling; a filing system; a security system and command processing software. Despite its name, Famos bears no relation to IBM's operating system MVT. Scheduling is handled by an algorithm which allocates varying (interleaved) intervals of CPU access to queued tasks on a priority basis, there being 16 priority levels. Memory is allocated from a free-memory pool on a 'best fit' basis which works in conjunction with a fragment collection scheme. The operating system occupies 32 kbytes of memory, leaving a further 32 kbytes of addressable user memory, although bank-selection in 16 or 32 kbyte banks is supported. Incoming tasks are automatically assigned to the least busy bank.

All devices (ie, both I/O and mass-storage peripherals) are accessible through device drivers recognised by the file-system. Each mass storage device supports a single directory which records all the file names on the disk; file types (A for alphanumeric; B for Basic object files; C for machine code routines and E for Editor files); file sizes and file protection, which includes a password. Files can be protected from being opened, deleted, written-to, shared or having their names changed.

Security is via a password system which controls access at log-in and is also used to prefix user-files by placing certain automatic protection features on files so created. User names beginning with 'X' and file names beginning with 'C' are exempted from the security scheme — so users with a login name beginning with an 'X' (ie, system users) can access all files whereas ordinary users can access only their own files or those whose names begin with 'C'. Unfortunately, an ordinary user can gain the rights of a system user merely by prefixing a single ASCII character (specifically mentioned in the word-processing manual) to forbidden file names.

Fortunately, there is one further level of security. Utilities and file names can have individual passwords on them preventing use by anyone (including an 'X' user) who doesn't know the password. On the review system utilities such as SCRATCH (delete a file from the disk) had passwords. The implications of this are that the utilities are not available to users and all housekeeping is left to a system manager. The alternative (ie, making the utilities public in a single directory filing system) would only be contemplated by the naive.

The operating system can be built by a 'system generation' process during which details of the hardware configuration together with device drivers and such specifics as the numerical precision within the Basic run-time system (3-(3-18 decimal places). The relevant machine code segments can be brought together either by the link editor or, more interactively, by means of a special Basic program. Most modifications to the configuration or general system organisation will require regeneration of the system.

The entire operating system appears to be the work of one George Pilipovich

of MVT Microcomputer Systems whose article ('Multi-Tasking the 8080: Famos on Online System', *Interface Age*, February 1979) is recommended to readers who want more details. As a 'one-man show' the general feel of the system is that it seems to exhibit some idiosyncratic features which we hope to be able to illustrate in the following description of the command-line processor.

During log-in, a task is created called the 'Super Selector'. This is the (re-entrant) command-line interpreter and is the 'parent' of any other task the user initiates. Like its UNIX counterpart (the Shell), apart from its ability to spawn sub-tasks in this way, the Super Selector (SS) is not capable of initiating much processing in its own right. In fact, it will recognise only five commands which are in the Super Selector box. Unlike the UNIX shell, there appears to be no way to dispatch two or more simultaneous tasks from a single command line although it is possible to initiate sequences of commands on one line.

Apart from user-defined tasks (ie user programs) there are a variety of system tasks available to the user under the Super Selector. These are divided into 'functions' and 'utilities', the distinction being that a utility will require the 'Q' command for its initiation (eg, Q VERIFY, to check that disk sectors are good), while a function name is directly recognisable by the Super Selector (eg, COMPILE). It would have made for a nicer user interface if the Super Selector had a way of separating the two types of programs so the user did not have to remember when to put 'Q' in front of a utility call. Seven 'function files' are required on the floppy-disk based system in order to provide the Super Selector with its power. On the review machine, the system utilities and functions effectively tied up one of the two available disk drives.

The system functions are described in Table 1. The system utilities comprise a set of programs largely of the 'system administration' type which provide facilities to inspect and test various features of the hardware (disks and memory) or system (files, User Accounting Blocks, etc). Most ominous among them is CFIX, a routine to clear the compiler queue should it become 'frozen'.

Batch operations are supported on the system by means of a 'batch jobfile'. This is a special file on the disk which contains commands to the Super Selector and information about tasks to be run, where the input is to come from and the output to go. This is queued to a specially-created 'batch monitor' which behaves as a 'virtual' user without the benefit of a terminal.

All in all, we found the system had an archaic (sixties) feel and was fairly awkward to use. Once a function is initiated, it always prompts for the file-names it requires, eg, user types COMP-FILE; system replies with ENTER SOURCE, OBJ, MESSAGE FILE NAMES. In fact, it is possible to enter these file names on the same line (the user invariably knows what files are expected so the prompt is not really necessary) by placing a full-stop between the command and its parameters, but the prompt appears anyway. Secondly, we found it a nuisance to have to create files in advance of using them — a more 'user-friendly' operating system would automatically create any files like object, message or source files. Thirdly, there are hardly any defaults or wildcards on the system, so that far more typing is required than on any other system we've seen. Finally, since the Basic run-time system is memory resident and too big to coexist in memory (on a single user 64k system) with the compiler, we found that the normal EDIT-COMPILE-RUN cycle, which one adopts during development, became something like:

CREATE source file
CREATE message file
CREATE-C object file
EDIT source file
COMPILE
→ RUN
EDIT
COMPILE — crashes because there isn't enough room in memory
PROGRAMS — so see what is going on
RELEASE — to get Basic out memory
CFIX — to clear the compiler queue
cycle back to →. Admittedly, this reflects the experience of new users but we've never run out of memory on any other machine (many with a lot less than 64k) when testing the Basic benchmarks.

Editors

There are two editors of the Famos system, the first a simple line-editor; the second a screen-oriented word-processing package called Wordflow.

The line-editor (invoked by the command EDIT), prompts with a '>' symbol, once the requisite file-name has DELT line number (delete line), EDIT line number (find and display line for editing), ENDE (terminate edit), LIST (list whole files) are recognised. Anything else must be an input line preceded by a four-digit (no more, no less) line number. Utilities exist, external to the editor, for removing, replacing or altering line-numbers. One rather surprising feature of the DELT command arises when the specified line number does not exist on the file. In this situation, instead of simply issuing an error or warning message, the editor will delete the next highest line — so any mis-keying could have some unpredictable and fairly disastrous results.

Once a line has been referenced for editing, control keys are used to position the cursor on the line and effect any editing as follows: CNTRL G — move cursor one character to right; CNTRL H — Move cursor one character to left; CNTRL I — insert one character to the left of cursor (if more than one character needs to be inserted, then before the string is input, CNTRL I must be typed once for each character in the string); SPACE BAR — delete one character.

Once ENDE is typed, certain automatic housekeeping functions are performed on the file (basically, all the modifications are linked into the file) so that it is not immediately available for further processing. We thought that this seemed a fairly ordinary sort of line editor, much along the lines of the editing facilities to be found on most interpreted Basic systems.

MVT-Wordflow is the word-processor package. It consists of a suite of programs which includes a screen-editor and various printing programs. The screen-editor can be used by any number of users simultaneously (ie it is 're-entrant'), but separate copies of the printer programs are required when more than one user wants to output. The user has control over how much of a file can be in memory at any one time during editing — obviously for one user, the greatest convenience would be to have the whole file present, but clearly this isn't always possible in a busy

(i) User Accounting Functions
- ACCOUNT — Displays cumulative account
- ADDUAB & DLUAB — used for creating and deleting a possible user
- PUAB — for printing out possible users
- PRESET-LOG & WRITE-LOG

(ii) Monitoring Functions
- BANKS — displays status of each memory bank
- CORE — displays free memory
- MAP — displays disk file directory
- PASSWORDS — displays file directly with password
- PROGRAMS — gives status of non-resident programs in memory
- TASKS — displays status of tasks owned by the terminal
- USERS — displays names of all users logged on
- LOC-TASK — like TASKS but for all users

(iii) Processing Functions
- CREATE & CREATE-C — for creating files
- COMPILE
- EDIT
- PRINTER — puts file in printer queue
- SCRATCH & SCRATCH-C — for deleting files
- RUN

(iv) Altering Functions
- CHANGE — change name (or password) of a file
- FREES — releases functions from memory
- LOADKP — loads and locks down programs in memory
- LODn — loads a specific function
- MERGE-M — merges files
- MOVE — move a file
- RELEASE — release a non-resident program
- SUPER-ZAP — used to end or suspend any task in the system
- TRMTYPE — for patching a specific terminal driver
- SETIME & TIME
- SEND — for interterminal messages

Table 1 Super Selector functions

multi-user environment. The manual recommends a 3-4 kbyte memory 'buffer'. There is also a buffer between the keyboard and the screen so that a typist can type ahead of the editor.

In non-edit mode, the editor can be used to move files to and from disks, create temporary files and define formatting details such as margin and paragraph spacings, etc. Standard formats can be saved on special files and invoked, where appropriate, during editing. Non-edit mode operates around a menu system and a 'help' command can be used to provide extensive guidance during operation. Edit mode allows both for text-input and for text-editing. Normal cursor-control, insertion and deletion (in units of characters, words, paragraphs or pages) facilities are provided, together with a number of more sophisticated features like printer control (eg, boldface, underlining, sub- and super-scripts) and 'customisation symbols'. Customisation symbols can be positioned in the text at places where information held on other files needs to be substituted at a later stage in the preparation of the document. Thus a file of customers' names or a list of prescribed phrases can effectively be merged with the textfile. Headers and 'footers' can be attached to the top and bottom of each page output, and blocks of text can be moved about within the file — so the editorial tasks of 'cutting and pasting' are supported.

The printer programs are WD. DIABLO (for intelligent word-processing type printers) and WD. OUTPUT (for the simple printers). Each features a menu which enables the user to set some of the formatting parameters and choose the number of copies required, etc.

We felt that Wordflow offered some fairly powerful facilities but was slightly clumsy to use — for instance, temporary backup files have to be created by the user (since they will always be required, the package ought to do this automatically). These files hold the modifications made to the actual file during the current and previous edits and a separate operation is required to merge the temporaries with the original — and this must be done before the temporary file gets too large. Sometimes we found that the text appearing on the screen wasn't quite what we had expected (or typed in), although these oddities seemed to disappear when the file was sent to the line-printer. Some of the functions required rather more keystrokes than would be strictly necessary (eg, delete character immediately before the cursor = ^D^C), but one would expect these to be customised to the user's terminal in a word-processing environment anyway. Finally, character positioning across the line is done relative to the left-hand margin rather than the left-hand edge of the screen — so if the left-hand margin is set to ten spaces, say, and the right-hand margin set to 60, then the text will occupy character positions 10-70, rather than the 10-60 which typists would expect with that specification.

Basic

MVT-Basic offers most of the facilities onw would expect in a 'large' micro-implementation of Basic, including a convenient path to some useful system utilities especially for commercial programs. Multiple statements on a line are permitted, together with up to eight-character variable names. Strings have (by default) a length of 80 characters, although this may be increased (or decreased to save space) by means of the size command. The IF-THEN-ELSE construct is not supported.

Disk-files are available as serial access (via PRINT and INPUT), random access (via GET and PUT) and ISAM (via a set of machine language calls) files. ISAM, which stands for 'index sequential access method', is a sort of compromise between random and serial access files. Records are stored like random records but their locations are recorded in a series of index files which are sorted according to 'key' values within each record. Two sorting utilities (one for main memory, one for disk files) are available to help to keep the key files under control.

A full library of arithmetic, string-handling and formatting functions is available, together with the ability to implement new library functions. Calling library routines and assembly language routines (8080 or Z80) may have parameters passed to them. Batch monitors may be initiated within a Basic program and a variety of file-handling and terminal output control routines are available on the same basis. These make Basic a powerful development system for the production of commercial programs, notwithstanding our reservations about the overall awkwardness of the operating system and our doubts about the wisdom of using Basic for commercial program development.

The compiler generates (line by line) pseudo-code object programs which may be submitted to one of three run-time systems — Basic (for 8080 machine code); BasicZ (for Z80 machine code) and Basic DBUG for debugging. This is a clever arrangement, since it allows for a certain amount of flexibility and tuning of the relevant run-time systems without committing the compiled objects to any given source program. However, as our benchmark results show, neither the arithmetic nor file-handling functions show the benefit of the extra efficiency of Z80 code.

The debugging run-time system allows the user to set and clear breakpoints, display the contents of variables and start the execution at any place in a program. The compiler produces a source listing with hex numbers before the Basic line numbers and a symbol table where each variable is given a hex value. It is these compiler-generated hex numbers, rather than the Basic line numbers and variable names, which the debugger references. It is a pity that the debugger designer requires the programmer rather than the debugger to remember these references. Debuggers are much easier to use when they refer to Basic variable names and line numbers.

One irritation we found was in the format of the individual Basic statement, where the line-number is represented in BCD (with a maximum of 9999), while the rest of the line is in ASCII. The line-editor can cope with this but Wordflow, the wordprocessor, requires special provision. Each BCD number must have a control character preceding it (a lesson we learned the hard way).

Benchmarks

We ran the single-user benchmarks under both run-time systems. The multi-user benchmarks were run in single-user mode on the floppy-based review machine (using both the 8080 and Z80 run-time systems) and with up to four users on Microtek's hard-disk system, using the 8080 Basic. Rather than getting involved in discussions about how one would go about extrapolating these figures to cover all configurations, we shall present our timings without (much) comment. All times are in seconds.

We were at a loss to explain the performance of the hard-disk system on the terminal test in single-user mode (longer than with floppies) and on the Multiple Open disk access test with three and four users. We can only assume that, since four terminals were always logged into this system (though inactive) while the single-user tests were being run, there is a certain system overhead in servicing the inactive users; also, the lock-out mechanism, which comes into play when more than one user tries to access the same file, works more efficiently when several users are queued for access.

Finally, the last table reflects the fraction of the single user time which is taken, per terminal, when running the multi-user tests. If this figure is greater than 1, it would be more efficient to run the jobs in sequence. As expected, the processor test shows some degradation in response. The others show a remarkably buoyant system (up to four users), especially the anomalous test 3.

Potential

Although not every type of multi-user application could be sensibly put onto a single Z80 processor, there are many applications which are not particularly processor-bound and where Famos, running on a suitable hardware configuration, might be satisfactory. Microtek Computer Services, who supplied the review machine, uses Famos to develop commercial software and has spent quite a bit of time developing its own utilities and tuning the operating system. Apparently MVT will accept and distribute its own utilities, as well as those from other software houses. So anyone thinking of setting up a commercial operation could get some help with tailoring a friendly development system. As it was, however, we felt that the standard system software was a little too stilted and unhelpful to make for a really smooth development environment.

This type of tuning takes time and would require someone with a good working knowledge of assembly language programming. Microtek found the ISAM file structure (which is not particularly well-handled in the manuals) very useful for the production of its commercial software. All the file handling in Basic employed a lock-out system to prevent more than one user from accessing (or corrupting) the same record at the same time. Routines exist in assembler so that the system programmer can easily set up file-protection. However, it is unusual to find a commercial applications programmer capable of, or willing to, program

more than a tiny bit of his work in assembler, and the only other language at present on the system is Basic, although according to Microtek, an arrangement has been made so that Pascal/Z may be implemented.

For the businessman, the major advantage of Famos is that it has been around for several years and in use in a number of software houses. Microtek, for instance, has multi-user integrated accounting, stock control and banking packages. There is very little commercial multi-user software currently available for an eight-bit micro, so if that's what is needed and if the package handles nicely (the ones we saw seemed to, although we did not study them in depth), the Famos system could be worth going for. However, the cost of such multi-user software could reflect the time and effort needed to bring it into being under Famos.

Turning to the educational market, we thought Famos would be a poor choice for a school system. Firstly, it lacks any graphical capabilities and has a very limited choice of programming languages. Secondly, and more importantly, it does not handle the new development user gently enough — this may not matter to the intelligent extrovert programmers in a class; it's the diffident plodders who risk being put off computing for life. Thirdly, the system requires a systems programmer and/or manager to set it up and perform constant housekeeping chores, and this individual is a luxury which few schools can afford. Finally, the system does not particularly recommend itself as a laboratory tool as there are no device drivers for data-logging equipment and suchlike, and the mathematical subroutine library (part of the operating system, and not of Basic) is too slow for much number-crunching.

A Famos system could be employed as a multi-station word-processing system — and, according to Microtek, it is used for this purpose by the US Navy. Wordflow, being menu-driven, is reasonably powerful and easy to use, although it is not as easy to use as some others we have seen. In the multi-user context, however, Wordflow has the advantage of being re-entrant — so with only one copy of the program in memory and with a good spooling program to the printer, the system could be loaded up with quite a few typists without suffering severe response problems. However, for this sort of application, a hard-disk subsystem is a virtual necessity, since Wordflow employs a tiny memory-buffer for the text-file so the higher transfer rate offered by the hard-disks would be another vital factor in keeping the response buoyant.

Documentation

The Famos documentation came in two large ring binders and comprised a user manual; a Basic programmer's guide; a Wordflow manual and a program development manual. Our overall impression was that these had been prepared with greater care than is usual in the micro-world. All were paginated, had a detailed table of contents and were well laid-out. In the programming sections, each instruction is given a full page which includes a definition of the instruction, an explanation of its function and a full example. At the end of the section, all the instructions are summarised with a one-line description. The style of the text is slightly patronising in tone (eg, 'It is absolutely essential that all of the General Consideration section be read carefully prior to the use of Famos') and is given to rather sweeping statements (eg, 'The system is designed to virtually preclude system crashes owing to user errors'). Nevertheless, the manuals seemed to provide a good overall introduction to the system, although there may have been room for a coherent description of the design philosophy and a bit more depth on the workings of certain features, particularly the filing system.

The one manual we didn't like was the Wordflow manual. This consisted of 165 pages of description supposedly aimed at the secretary. Every feature therefore is described in laborious detail with every option and possible outcome spelled out. The result is that it is page 62 before one finds out exactly how one goes about actually typing some text in. There is no real overview given and no short-cut. (In fact, the introduction states: 'It is extremely important that this manual be read sequentially and carefully.') Obviously, this sort of detail is necessary to enable the frequent 'professional' user to get acquainted with all the features and to become an expert, but both the beginner and the casual user need a simple set of instructions showing how to set up a standard sort of text-file and get it printed out.

Timings

Single User	8080 (Basic)	Z80 (Basic)
BM1	1.4	1.1
BM2	3.4	2.5
BM3	7.3	5.7
BM4	16.1	14.2
BM5	17.1	14.8
BM6	25.6	21.7
BM7	30.5	25.8
BM8	81.2	81.2

Note BM8 tests arithmetic subroutine library.

Conclusion

MVT Famos is a multi-user oprating system that runs on a single (8080 family) processor. We spoke to a dealer who sells several multi-user operating systems for 8080s and asked him why people chose Famos. His reply was that Famos stood up better to a large number of terminals than did the other operating systems available.

In its favour, Famos offers a high standard of documentation, nice utilities for file handling, three Basic run-time systems and a word processing package. Most of the software can be re-entrant although this sharing is dependent on the way the memory is divided up.

The major disadvantage of Famos is that it is an unfriendly operating system that requires the programmers and system managers to spend a significant percentage of their time doing housekeeping on the system. In this day of pricey programmers and £10 processors, a software house could probably find that the overall cost of the packages they produced was lower on a more expensive configuration.

IMS Prices in £s.

Desk top system, 64k dynamic RAM, three double side 5in double density floppy disk drives, giving 900k storage	2362.00
Desk top system, 64k dynamic RAM, two single sided 8in double density floppy disk drives, giving 1Mb storage	2720.00
Desk top system, 64k dynamic RAM, two double sided 8in double density floppy disk drives, giving 2Mb storage	2964.00
Desk system, 128k dynamic RAM, three double sided 8in double density floppy disk drives (3Mb storage)	4679.00
Desk top system, 128k dynamic RAM, four double sided 8in double density floppy disk drives (4Mb storage), two serial I/O boards	5341.00

Multi-User	Tests (One User)	8080 (floppies)	Z80 (floppies)	8080 (hard disk)
	Processor test	30.5	25.8	30.1
Test disk	Single Open	40.1	39.9	7.6
file access	Multiple Open	222.1	221.7	76.1
	Terminal Test	55.4	51.7	69.1

Multi-User (8080 with hard disk)	1 user	2 users	3 users	4 users
processor test	30.1	63.4	100.4	134.6
single open disk access	7.6	11.6	16.3	21.3
multiple open disk access	76.1	93.6	73.8	87.3
terminal test	69.1	99.7	143.1	185.7

Percentage of single user times

	Users	1	2	3	4
Tests	1	1	1.05	1.11	1.12
	2	1	0.75	0.71	0.70
	3	1	0.61	0.32	0.29
	4	1	0.91	0.87	0.85

Q = queue — initiate named subtask. This will create the new entry in the appropriate tables and begin execution. For example, to see a file the program DISPLAY must be executed which is done by 'Q DISPLAY'. Control can be returned to the Super Selector by pressing the ESC key.
S = suspend — stop execution of named task. This command is probably not used much since for most needs ESC performs the same function.
R = resume — continue execution of previously suspended (by S or ESC) task. If the letter W is typed after the task-name, control of the terminal will be passed to the task : otherwise control remains with the current task.
E = end — discontinue execution of named subtask and remove from memory.
O = off — log out terminal

Table 2 Super Selector commands

Microtek rack system prices

MRS-32D — 128k dynamic RAM, 32Mb Phoenix hard disk drive, (16Mb fixed & 16Mb cartridge), four serial and two parallel ports, rack mounted 8064.00

MRS-96D — As MRS-32D but with 96Mb hard disk drive (80+16) 9309.00

Famos operating system

MVT Famos operating system including: Basic compiler, utilities, assembler system, run time system, 'Wordflow' word processing, and manuals 889.00

Software

1 — MCS full accounting system (sales, purchase and nominal ledgers)	1500.00
1 — MCS stock control system	1000.00
1 — MCS payroll system	LEASE
1 — MCS client information and mailing system	850.00
1 — MCS plant hire system	1000.00
1 — MCS job costing system	1000.00
Utilities	10—250

Other systems POA

Peripherals

Texas TI810 matrix printer (150 cps), Full ASCII, paper tray and stand	1280.00
Oki Microline 82 matrix printer	550.00
Lyme 5080 VDU	900.00
TVI 912c VDU	595.00

Manuals only £30

WRITING FOR PCW

PCW welcomes approaches from would-be writers, even those who may never have appeared in print before. In this game it is often those with practical experience who have important things to say so we don't mind too much if their prose is less than perfect. Providing that submissions have a sensible structure and follow a logical sequence, we can take care of the polishing. Here are some tips:

If the article is already written, simply send it in, making sure that your name, address and 'phone number appear on both the article and the covering letter. If you have submitted the same work to other magazines you should tell us — it would be embarrassing (to say the least) if the same article appeared in more than one.

If you have an idea for an article or a series, write us a letter outlining your ideas. A one or two page synopsis giving the proposed structure, sequence and content will give us a sound basis for discussion. Please give us a daytime 'phone number if possible.

If you have nothing specific in mind but feel qualified to conduct case studies, Benchtests or whatever then drop us a line saying what you'd like to do and why you think you're qualified to do it. We're not particularly looking for strings of academic qualifications — experience carries just as much weight.

Dick Pountain is always on the look-out for interesting calculator features and we wouldn't mind seeing one or two readers getting on their soapboxes but remember: even articles such as this need a structure.

Reading *PCW* will give you a good idea of the style we prefer. You may notice that we try to avoid pomposity at one extreme and flippancy at the other (except in 'Chip Chat', that is).

Finally, have a look through back issue indexes and try not to re-invent any wheels. Oh, we almost forgot — *PCW* does pay for all published work.

MICRO CHESS

Continued from page 78

All the major manufacturers were displaying their wares in Las Vegas. I will deal with them alphabetically.

Applied Concepts unveiled its new modular chess program for its Modular Game System. The program consists of three modules called Grunfeld, Morphy and Capablanca (three famous chess players of the past) — they cover, respectively, the opening, middle game and endgame. The Morphy module, however, also contains enough opening and endgame knowledge to stand on its own as a complete program, the other modules being used for their respective phases of the game to improve the overall playing strength. This is one of the four new programs announced which is definitely stronger than anything at present on the market.

Fidelity Electronics, last year's market leader in both unit volume and turnover, unveiled a completely new item: a pocket set with a sensory board, pieces that plug into holes on the sensory board and three levels of play. Fidelity also had the old Voice Challenger program ensconced in a large wooden chess table.

The new program for the Sensory Voice Challenger, based on the Spracklen's program which won the World Microcomputer Championship at last year's *PCW* show, was not on show and probably will not be unveiled before the Chicago Consumer Electronics Show in June. Though that is unlikely to be running at 4 MHz in the production unit, it, too, will be stronger than anything currently on the market.

The giant Mattel Electronics entered the field with a small pocket unit called, enterprisingly, 'Computer Chess'. The advertising blurb refered to it playing 'brilliant chess', which owes rather more to the inbuilt LCD chess board than to the quality of performance of the playing program.

Novag, previously a distributor of SciSys products, has now ventured into the field of manufacture. It unveiled a whole range of excitingly designed units and if looks were everything it would capture the entire computer chess market. The software is provided by Dave Kittinger, using his Mychess program.

At the bottom of the Novag range is the 4k Micro Chess with, like the Fidelity unit, a sensory board and plug-in pieces. Next in line is the 8k Super Sensor IV with Fidelity-type sensor board. It was, though, the two units at the top of their range, both using a 24k version of Mychess, that aroused the greatest interest. Savant has an LCD chess board display combined with sensor touch technology. With this technique the user simply touches the piece on the LCD that he wants to move and then touches the square to which he wants to move the piece and that's it. Then there was the super-sleek Robot Adversary. Unlike Applied Concepts' Boris Handroid, this does not use an 'x,y plotter' approach but has a true robot arm. A most impressive entrance to the market place by Novag.

SciSys now has the largest range of machines on the market. In Las Vegas it unveiled Junior Chess and Graduate Chess, Chess Executive, Sensor Chess and the Chess Champion Mk V. Junior and Graduate Chess each have a 2k program and will retail respectively for about £20 and £30 or less. The Chess Executive is quite a strong 4k program with built-in LCD chess board and a unique cursor system for moving the pieces which requires no knowledge of chess notation on the user's part. All three of the above units are battery operated and pocket-size. Sensor Chess is a modular system with a basic 4k module, expandable to 6k or 8k, and its sensor board is of an improved type requiring less pressure on the squares to register piece movement. Top of the line was the new SciSys flagship, the Chess Champion Mk V.

Chess Champion Mk IV

		R1	R2	R3	
1	Mephisto X	D2	W6	W4	2½
2	Boris ARB 2.5	D1	D5	W7	2
3	Boris MGS 2.5	L4	W8	W6	2
4	Mychess	W3	W7	L1	2
5	Challenger Sensory Voice	L6	D2	W8	1½
61	Rook 4.0/4.5	W5	L1	L3	1
7	Challenger 8	W8	L4	L2	1
8	Princhess 1.2	L7	L3	L5	0

Table 2

The second European Microcomputer Chess Championship will take place during the 4th PCW *Show, 10-12 September 1981. For details, send a large SAE to: European Microcomputer Chess Championship,* PCW, *14 Rathbone Place, London W1P 1DE.*

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NEWCOMERS-START HERE

This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in PCW. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say 'numbering system with a radix of 16 in which the letters A to F represent the values ten to 15' when instead we can simply say 'hex'. No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, *PCW* will be publishing this guide — every month.

We'll start by considering a microcomputer's functions and then examine the physical components necessary to implement these functions.

The microcomputer is capable of receiving information, *processing* it, storing the results or sending them somewhere else. All this information is called *data* and it comprises numbers, letters and special symbols which can be read by humans. Although the data are (yes, it's plural) accepted and output by the computer in 'human' form, inside it's a different story — they must be held in the form of an electronic code. This code is called *binary* — a system of numbering which uses only 0s and 1s. Thus in most micros each character, number or symbol is represented by eight binary digits or *bits* as they are called, ranging from 00000000 to 11111111.

To simplify communication between computers, several standard coding systems exist, the most common being *ASCII* (American Standard Code for Information Interchange). As an example of this standard, the number five is represented as 00110101 — complicated for humans, but easy for the computer! This collection of eight bits is called a *byte* and computer freaks who spend a lot of time messing around with bits and bytes use a half-way human representation called *hex*. The hex equivalent of a byte is obtained by giving each half a single character code (0—9,A—F): 0=0000, 1=0001, 2=0010, 3=0011, 4=0100, 5=0101 ..... E=1110 and F=1111. Our example of 5 is therefore 35 in hex. This makes it easier for humans to handle complicated collections of 0s and 1s. The machine detects these 0s and 1s by recognising different voltage levels.

The computer processes data by reshuffling, performing arithmetic on, or by comparing them with other data. It's the latter function that gives a computer its apparent 'intelligence' — the ability to make decisions and to act upon them. It has to be given a set of rules in order to do this and, once again, these rules are stored in *memory* as bytes. The rules are called *programs* and while they can be input in binary or hex (*machine code* programming), the usual method is to have a special program which translates English or near-English into machine code. This speeds programming considerably; the nearer the *programming language* is to English, the faster the programming time. On the other hand, program execution speed tends to be slower.

The most common microcomputer language is *Basic*. Program instructions are typed in at the keyboard, to be coded and stored in the computer's memory. To *run* such a program the computer uses an *interpreter* which picks up each English-type *instruction*, translates it into machine code and then feeds it into the *processor* for execution. It has to do this each time the same instruction has to be executed.

Two strange words you will hear in connection with Basic are *PEEK* and *POKE*. They give the programmer access to the memory of the machine. It's possible to read (PEEK) the contents of a byte in the computer and to modify a byte (POKE).

Moving on to *hardware*, this means the physical components of a computer system as opposed to *software* — the programs needed to make the system work.

At the heart of a microcomputer system is the central processing unit *(CPU)*, a single microprocessor chip with supporting devices such as *buffers*, which 'amplify' the CPU's signals for use by other components in the system. The packaged chips are either soldered directly to a printed circuit board *(PCB)* or are mounted in sockets.

In some microcomputers, the entire system is mounted on a single, large, PCB; in others a *bus system* is used, comprising a long PCB holding a number of interconnected sockets. Plugged into these are several smaller PCBs, each with a specific function — for instance, one card would hold the CPU and its support chips. The most widely-used bus system is called the *S100*.

The CPU needs memory in which to keep programs and data. Microcomputers generally have two types of memory, *RAM* (Random Access Memory) and *ROM* (Read Only Memory). The CPU can read information stored in RAM — and also put information into RAM. Two types of RAM exist — *static* and *dynamic*; all you really need know is that dynamic RAM uses less power and is less expensive than static, but it requires additional, complex, circuitry to make it work. Both types of RAM lose their contents when power is switched off, whereas ROM retains its contents permanently. Not surprisingly, manufacturers often store interpreters and the like in ROM. The CPU can only read the ROM's contents and cannot alter them in any way. You can buy special ROMs called *PROMs* (Programmable ROMs) and *EPROMs* (Erasable PROMs) which can be programmed using a special device; EPROMs can be erased using ultra-violet light.

Because RAM loses its contents when power is switched off, *cassettes* and *floppy disks* are used to save programs and data for later use. Audio-type tape recorders are often used by converting data to a series of audio tones and recording them; later the computer can listen to these same tones and re-convert them into data. Various methods are used for this, so a cassette recorded by one make of computer won't necessarily work on another make. It takes a long time to record and play back information and it's difficult to locate one specific item among a whole mass of information on a cassette; therefore, to overcome these problems, floppy disks are used on more sophisticated systems.

A floppy disk is made of thin plastic, coated with a magnetic recording surface rather like that used on tape. The disk, in its protective envelope, is placed in a disk drive which rotates it and moves a *read/write head* across the disk's surface. The disk is divided into concentric rings called *tracks*, each of which is in turn subdivided into *sectors*. Using a program called a *disk operating system*, the computer keeps track of exactly where information is on the disk and it can get to any item of data by moving the head to the appropriate track and then waiting for the right sector to come round. Two methods are used to tell the computer where on a track each sector starts: *soft sectoring* where special signals are recorded on the surface and *hard sectoring* where holes are punched through the disk around the central hole, one per sector.

Half-way between cassettes and disks is the *stringy floppy* — a miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disk system. *Hard disk* systems are also available for microcomputers; they store more information than floppy disks, are more reliable and information can be transferred to and from them much more quickly.

You, the user, must be able to communicate with the computer and the generally accepted minimum for this is the visual display unit *(VDU)*, which looks like a TV screen with a typewriter-style *keyboard*; sometimes these are built into the system, sometimes they're separate. If you want a written record *(hard copy)* of the computer's output, you'll need a *printer*.

The computer can send out and receive information in two forms — *parallel* and *serial*. Parallel input/output *(I/O)* requires a series of wires to connect the computer to another device, such as a printer, and it sends out data a byte at a time, with a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single piece of wire, with extra bits added to tell the receiving device when a byte is about to start and when it has finished. The speed that data is transmitted is referred to as the *baud rate* and, very roughly, the baud rate divided by ten equals the number of bytes being sent per second.

To ensure that both receiver and transmitter link up without any electrical horrors, standards exist for serial interfaces; the most common is *RS232* (or *V24)* while, for parallel interfaces to printers, the *Centronics* standard is popular.

Finally, a *modem* connects a computer, via a serial interface, to the telephone system allowing two computers with modems to exchange information. A modem must be wired into the telephone system and you need British Telecom's permission; instead you could use an *acoustic coupler*, which has two obscene-looking rubber cups into which the handset fits, and which has no electrical connection with the phone system — British Telecom isn't so uppity about the use of these.

PACKAGES

DIRECT ACCESS

PCW's 'Packages' section is produced bi-monthly, alternating with our 'In Store' hardware guide. We have confined coverage to business packages which are available and supported at national level and which have been in use for at least six months in a minimum of five sites. Producers of packages which fall within these constraints should send details or updates to: **Packages,** *PCW,* **14 Rathbone Place, London W1P 1DE.**

The layout has been designed to allow you to discover which packages are available for the application you have in mind and to show you which packages are available for your computer if you already have a machine. In either case the code enables you to look up the supplier's name and telephone number in the table below.

Code	Company	Telephone
A1	ACT/Petsoft	021-454 5348
A2	Arden Data Processing	0533 22255
B1	B + B Computer Ltd.	0204 26644
B2	Beam Business Centre	01-636 1392
B3	Benchmark Computer Systems	0726 61000
B4	Bristol Software Factory	0272 23430
C1	CAP-CPP Products Ltd.	01-404 0911
C2	Commodore	01-388 5702
C3	Compsoft	0483 39665
C4	Comput-a-crop	01-499 6987
C5	Computastore Ltd.	01-499 6987
C6	Computech	01-794 0202
D1	Data Bank	0509 217671
G1	Graffcom Systems Ltd.	01-734 8862
G2	Grama (Winter) Ltd.	01-636 8210
G3	Great Northern	0532 450667
H1	A.J. Harding	0424 220391
H2	Hartford Software	0606 76265
H3	H.B. Computers	0536 83922
H4	Hipposoft	0332 23127
I1	Intereurope Software Design	0734 786644
I2	Intex Datalog Ltd	0642 781193
J1	T.V. Johnson	0276 62506
K1	Katanna Management Services	0245 76127
K2	Keen Computers	0602 583254
L1	Lifeboat Associates	01-836 4663
L2	Liveport (Exidy Sorcerer Firmware)	0736 798157
L3	Ludhouse (Computing) Ltd.	01-679 4321
M1	Micro Computer Applications Ltd.	0734 470425
P1	Padmede Computer Services	025671 2434
P2	Personal Computers Ltd.	01-626 8121
R1	Rockliff	051-521 5830
S1	SMG Micro Computers	0474 55813
S2	The Softwarehouse	01-637 2108
S3	Stage One Software	0202 23570
S4	Systematics International	0268 284601
S5	Sumlock Bondain	01-250 0505
T1	Tridata Micros Ltd.	021 622 1754
V1	Vlasak Electronics Ltd.	062-84 74789

Applications

Application	Machine	Price	Code
Appointments planner	Commodore/ Computhink	£100	S3
Assembler dev	PET/CBM	£50	L2
Bank accounts	Apple II	£10	D1
	Commodore/ Computhink	£100	S3
	ITT 2020	£10	D1
	PET	£10	D1
Bonds/pension quotations	Commodore/ Computhink	£100	S3
Budgeting package	MCZ Zilog	£500+	I1
Bureau de change	CBM	£8	H3
Cash flow	Apple II	£75	P2
	Apple II	£80	V1
	CP/M	£250	L3
	PET	£8	A1
Cash register	Apple II	£10	D1
	ITT 2020	£10	D1
	PET	£10	D1
CBasic	Tandy Model II	£70	M1
Company secretary	CP/M	£450	C4
Conference organiser	MCZ Zilog	£500+	I1
Contract costing	CP/M	£2000	L3
CP/M & utilities	Tandy Model II	£150	M1
Credit control	Apple II	£98	P2
	PET	£650	B4
Database management/Information retrieval	ACT800	£225	H4
	Apple	£150	A2
	Apple	£150	K2
	Apple	£60-140	S2
	Apple	£150	S5
	Apple II	£98	P2
	Aple II/ITT 2020	£100	S4
	Commodore/ Computhink	£45-250	S3
	CP/M	£150-750	C4
	Cromemco	£250	B3
	North Star Horizon	£250	B3
	PET	£170	C3
	PET	£325	A1
	PET	£225	H4
	PET/CBM	£75	B1
	PET/CBM	£50/150	C2
	PET/CBM	£150	J1
	PET/CBM	£150	G2
	Tandy Model I	£25-80	M1
	TRS-80	£60	S2
	TRS-80	£150	J1
	TRS-80	£32.50	H1
	8000 Series	POR	C2
Disk operating system	PET/CBM	£150	B1
Estate agent	Apple	£850	A2
	Apple	£850	S5
	Apple	£850	K2
	Apple II	£175	P2
	Apple II/ITT 2020	£750	S4
	CBM	£30	H3
	Commodore/ Computhink	£250	S3
	CP/M	£750	C4
	PCC 2000 Simpelec Triton 3	£350	B3
	PET	£25	A1
Equipment lease/rent/HP	CP/M	£400	G1
Financial modelling	CP/M	£400	G1
Financial planning	Apple II/ITT2020	£250	S4
General ledger/NL	Apple	£300	A2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£295	P2
	Apple II	£225	V1
	Apple II	£295	C6
	CBM	£200	H3
	Commodore/ Computhink	POR	S3
	CP/M	£500	L3
	CP/M	£500	K1
	CP/M	£375	L1
	CP/M	£500	C4
	CP/M	£400	G1
	Cromemco	£250	B3
	ITT 2020	£295	C6
	ITT 2020/Apple II	£250P	S4
	North Star Horizon	£250	B3
	PCC 2000 Simpelec Triton 3	£350	B2
	PET/CBM	£200	C2
	Tandy Model I	£90	M1
	Tandy Model II	£90	M1
	TRS-80	£225	H1
	TRS-80 I	£225/325	T1
	TRS-80 I	£325	K1
	TRS-80 II	£425	T1
	Vector	£400	C5
	8080/Z80	£357	L1
	8080/Z80	£275	G3
Hire purchase	Cromemco	£400+	B3
Incomplete records	Apple	£250	S2
	Apple	POR	K2
	Apple II	£125	P2
	Commodore/ Computhink	£750	S3
	Tandy Model I	£40	M1
	TRS-80	£40	H1
Individual designed programs	TRS-80 I	£100+	K1
Integrated Accts	Altos (CP/M, MP/M)	£300	B1
	Apple II	£450	P1
	Apple II	£340	P2
	Apple II	£855	V1
	Commodore/ Computhink	POR	S3
	CP/M	£950	L1
	CP/M	£1500	C4
	CP/M	£1100	G1
	Cromemco	£950	B3
	ITT 2020	£450	P1
	MZ-80K	£150	P2
	North Star Horizon	£950	B3
	PET/CBM	£300	B1
	PET/CBM	(£50)	C2
	PET/CBM	£650	J1
	PET/CBM	£650	G2
	Tandy Model I	£350	M1
	Tandy Model II	£350	M1
	TRS-80	£75	J1
	Vector	£1000	C5
	8000 Series	POR	C2
	8080/Z80	£950	L1
	8080/Z80	£995	G3
Investment portfolio	TRS-80	£20	S2
Invoicing	Apple	£295	S2
	Apple II	£300	P1
	Apple II	£125	P2
	Apple II	£140	V1
	Commodore/ Computhink	POR	S3
	CP/M	£500	K1
	CP/M	£325	L1
Job costing	Apple II	£125	P2
	Apple II	£300	P1
	CP/M	£700	C4
	ITT 2020	£300	P1
	Tandy Model I	POR	M1
	Tandy Model II	POR	M1
Job order control	8080/Z80	£275	G3
Leasing	Cromemco	£400+	B3
Legal precedents	CP/M	£1100	C4
Letter writer	Apple II	£80	V1
Lisp	PET/CBM	£75	C2
Lotteries	PET	£45	H2
Mailing list	Altos (CP/M, MP/M)	£75	B1
	Apple	£300	A2
	Apple	£50-150	S2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£40	P2
	Apple II	£50	D1
	Apple II/ITT 2020	£100	S4
	CBM	£35	H3
	Commodore/ Computhink	£100	S3
	CP/M	£50-150	C4
	CP/M	£250	G1
	ITT 2020	£50	D1
	PET	£45	H2
	PET	£50	D1
	PET	£15	A1
	PET/CBM	£75	B1
	PET/8032	£75/150	S1
	Tandy Model I	£40	M1
	Tandy Model II	£75	M1
	TRS-80	£50-150	S2
	TRS-80	£25/38/55	H1
Mail shot	Apple	£14	S2
	Apple II	£225	P2
	Commodore/ Computhink	£125	S3
	CP/M	£200-360	C4
	MCZ Zilog	£250	I1
	PCC 2000 Simpelec Triton 3	£450	B2
	Tandy Model II	£75	M1
Membership acctng	PET	£85	H2
Order entry/invoicing	CP/M	£350	G1
Order processing	CP/M	£550	L1
	8080/Z80	£550	L1
Office admin	Apple II/ITT 2020	£100	S4
Pad to plotter systems	Apple II	£250	P2
Pascal	PET/CBM	£120	C2
Payroll	Apple	POR	A2
	Apple	£200	S2
	Apple	POR	S5
	Apple	POR	K2
	Apple II	£200	P2
	Apple II	£375	V1
	Apple II	£375	C6
	Apple II	£10	D1
	Apple II/ITT 2022	£250P	S4
	CBM	£10	H3
	CP/M	£450	L3
	CP/M	£500	K1
	CP/M	£475	L1
	CP/M	£495	C4
	CP/M	£500	G1
	Cromemco	£350	B3
	ITT 2020	£375	C6
	ITT 2020	£10	D1
	North Star Horizon	£350	B3
	PET	£200/350	C5
	PET	£50/25/195	A1
	PET	£50/195	I2
	PET	£10	D1
	PET/CBM	£150	G2
	PET/CBM	£150	J1
	PET/CBM	£150	C2
	Sorcerer	£250	L2
	Tandy Model I	£249	M1
	TRS-80	£200	H1
	TRS-80I	£218	K1
	TRS-80I	£218	T1
	TRS-80II	£375	T1
	8000 Series	£250	C2
	8080/Z80	£475	L1
	8080/Z80	£275	G3
Personnel records	Apple II	£98	P2
	CP/M	£450	C4
	MCZ Zilog	£500+	I1
	PET	£85	H2

DIRECT ACCESS

PACKAGES

Application	Machine	Price	Code
Petaid report generator	Commodore/ Computhink	£125	S3
Petsoft programs	PET/CBM	£160	J1
Planning/Maintenance	PET/8032	£595	S1
Postal advertising response package	Apple	£350	S2
PR/advertising package	Commodore/ Computhink	£1000	S3
Price lister	CBM	£12	H3
Printers job control	Commodore/ Computhink	£250	S3
Production analysis	Apple II	£75	P2
	CP/M	£700	C4
	PET/CBM	£300	B1
Prof appts groups	8080/Z80	£275	G3
Prof appts individ	8080/Z80	£220	G3
Prof client billing	8080/Z80	£330	G3
Programming aids	Apple II	£40	P2
Property management	CP/M	£450-1000	C4
Purchase ledger	Apple	£300	A2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£295	C6
	Apple II	£300	P1
	Apple II	£295	P2
	Apple II	£315	V1
	Apple II/ITT 2020	£250P	S4
	CBM	£350	H3
	Commodore/ Computhink	POR	S3
	CP/M	£500	C4
	CP/M	£450	G1
	CP/M	£500	L3
	CP/M	£500	K1
	CP/M	£425	L1
	Cromemco	£250	B3
	ITT 2020	£295	C6
	ITT 2020	£300	P1
	North Star Horizon	£250	B3
	PCC 2000 Simpelec Triton 3	£350	B2
	PET	£300	B4
	PET	£95/120/ 350	A1
	PET/CBM	£200	C2
	PET/CBM	POR	J1
	PET/8032	£395	S1
	Tandy Model I	£90	M1
	Tandy Model II	£90	M1
	TRS-80	£225	H1
	TRS-80I	£225	T1
	TRS-80I	£225	K1
	TRS-80II	£375	T1
	Vector	£400	C5
	8000 Series	£250	C2
	8080/Z80	£275	G3
	8080/Z80	£425	L1
Revolving credit	Cromemco	£400 +	B3
Sales ledger	Apple	£300	A2
	Apple	£300	S5
	Apple	£300	K2
	Apple II	£295	C6
	Apple II	£300	P1
	Apple II	£295	P2
	Apple II	£315	V1
	Apple II/ITT 2020	£250P	S4
	CBM	£350	H3
	Commodore/ Computhink	POR	S3
	CP/M	£500	C4
	CP/M	£450	G1
	CP/M	£500	L3
	CP/M	£500	K1
	CP/M	£425	L1
	Cromemco	£250	B3
	ITT 2020	£295	C6
	ITT 2020	£300	P1
	North Star Horizon	£250	B3
	PCC 2000 Simpelec Triton 3	£350	B2
	PET	£300	B4
	PET	£800	C1
	PET	£95/350	A1
	PET/CBM	POR	J1
	PET/CBM	£200	C2
	PET/8032	£395	S1
	Tandy Model I	£90	M1
	Tandy Model II	£90	M1
	TRS-80	£225	H1
	TRS-80I	£225	T1
	TRS-80I	£225	K1
	TRS-80II	£375	T1
	Vector	£400	C5
	8000 Series	£250	C2
	8080/Z80	£275	G3
	8080/Z80	£425	L1
Salesman	Apple II	£10	D1
	ITT 2020	£10	D1
	PET	£10	D1
Screen generator	MCZ Zilog	£75 +	I1
S/L, P/L & stock control	CP/M	£1000	L3
Solicitor's complete record accounting	Apple	£3000	S2
Solicitor's package	PET/8032	£750	S1
Statistics	Apple	£150	G3
	Apple II	£100-195	P2
	TRS-80	£45	S2
Stock control/ recording	Altos (CP/M, MP/M)	£300	B1
	Apple	POR	A2
	Apple	POR	K2
	Apple	POR	S5
	Apple	£150	G3
	Apple	£80	S2
	Apple II	£35/98	P2
	Apple II	£10	D1
	Apple II	£285	V1
	Apple II	£300	P1
	Apple II/ITT 2020	£500	S4
	CBM	£35/25	H3
	Commodore/ Computhink	£100/250	S3
	CP/M	£500	K1
	CP/M	£325	L1
	CP/M	£500-1500	C4
	CP/M	£350	G1
	Cromemco	£450	B3
	ITT 2020	£10	D1
	ITT 2020	£300	P1
	MZ-80K	£150	P2
	North Star Horizon	£450	B3
	PCC 2000 Simpelec Triton 3	£350	B2
	PET	£12/25/ 350	A1
	PET	£10	D1
	PET	£195	I2
	PET	£300	B4
	PET	£15	A2
	PET/CBM	£300	B1
	PET/CBM	£150	C2
	PET/CBM	£150	J1
	PET/CBM	£150	G2
	PET/Computhink	£250	R1
	PET/8032	£395	S1
	Tandy Model I	£30-50	M1
	Tandy Model II	£300	M1
	TRS-80	£48	S2
	TRS-80	£200	H1
	TRS-80	£115	J1
	TRS-80I	£200	K1
	TRS-80I	£200	T1
	TRS-80II	£375	T1
	8080/Z80	£275	G3
	8080/Z80	£325	L1
TAP business system	PET	£125	H2
Text file librarian	Apple II/ITT 2020	£125	S4
Time/cost recording	Apple	£450	S2
	Apple II	£300	P1
	Apple II	£125	P2
	Commodore/ Computhink	POR	S3
	CP/M	£400	G1
	Cromemco	£250	B3
	ITT 2020	£300	P1
	North Star Horizon	£250	B3
	PCC 2000 Simpelec Triton 3	£350	B2
	PET/CBM	£300	B1
	Tandy Model I	POR	M1
	Tandy Model II	POR	M1
Utilities	Apple II	£20	C6
	ITT 2020	£20	C6
Utility set	CBM	£78	H3
VAT	PET	£17.50	A1
VAT master	CBM	£25	H3
VAT register	TRS-80	£15	H1
Vet package	PET/8032	POR	S1
Video message	Apple	£200	G3
Warehousing	PET/8032	POR	S1
Word processing	ACT 800	£375	H4
	Apple	£60	S2
	Apple	£75	K2
	Apple	£75	S5
	Apple	£75	A2
	Apple II	£150-300	P2
	Apple II	£75	J1
	Apple II	£120	V1
	Apple II	£40	D1
	Apple II/ITT 2020	£180/95	S4
	CBM	£35	H3
	Commodore/ Computhink	£120	S3
	CP/M	£500	K1
	CP/M	£150-260	C4
	CP/M	£400	G1
	ITT 2020	£40	D1
	MCZ Zilog	£500 +	I1
	PET	£85/65/ 40/20	H2
	PET	£40	D1
	PET	£375	H4
	PET	£25/325	A1
	PET	£325	C5
	PET/CBM	£75/150	C2
	PET/CBM	£75/150	J1
	PET/CBM	£75/150	G2
	Tandy Model I	£50/75	M1
	Tandy Model II	£175-240	M1
	TRS-80	£30/60/90	S2
	TRS-80	£45/95	J1
	TRS-80	£15	H1
	TRS-80I	£70	K1
	Vector	£400	C5
	8000 Series	£250	C2

Machines

Machine	Application	Price	Code
ACT 800	Database management/	£225	H4
	Word processing	£375	H4
Altos (CP/M, MP/M)	Integrated accts	£300	B1
	Mailing list	£75	B1
	Stock control/recording	£300	B1
Apple	Database management/ information retrieval	£150	K2
	Database management/ information retrieval	£150	A2
	Database management/ information retrieval	£60-140	S2
	Database management/ information retrieval	£150	S5
	Estate agent	£850	S5
	Estate agent	£850	A2
	Estate agent	£850	K2
	General ledger/NL	£300	K2
	General ledger/NL	£300	A2
	General ledger/NL	£300	S5
	Incomplete records	POR	K2
	Incomplete records	£250	S2
	Invoicing	£295	S2
	Job costing	£450	S2
	Mailing list	£300	K2
	Mailing list	£300	A2
	Mailing list	£50-150	S2
	Mailing list	£300	S5
	Mail shot	£14	S2
	Payroll	POR	S5
	Payroll	POR	K2
	Payroll	POR	A2
	Payroll	£200	S2
	Postal advertising response package	£350	S2
	Purchase ledger	£300	K2
	Purchase ledger	£300	A2
	Purchase ledger	£300	S5
	Sales ledger	£300	A2
	Sales ledger	£300	K2
	Sales ledger	£300	S5
	Solicitor's complete record accounting	£3000	S2
	Statistics	£150	G3
	Stock control/recording	£150	G3
	Stock control/recording	POR	K2
	Stock control/recording	POR	A2
	Stock control/recording	£80	S2
	Stock control/recording	POR	S5
	Time/cost recording	£450	S2
	Video message	£200	G3
	Word processing	£75	K2
	Word processing	£75	A2
	Word processing	£60	S2
	Word processing	£75	S5
Apple II	Bank account	£10	D1
	Cash flow	£80	V1
	Cash flow	£75	P2
	Cash register	£10	D1
	Credit control	£98	P2
	Database management/ information retrieval	£98	P2
	Estate agent	£175	P2
	General ledger/NL	£225	V1
	General ledger/NL	£295	P2
	General ledger/NL	£295	C6
	Incomplete records	£125	P2
	Integrated accts	£855	V1
	Integrated accts	£450	P1
	Integrated accts	£340	P2
	Invoicing	£140	V1
	Invoicing	£300	P1
	Invoicing	£125	P2
	Job costing	£125	P2
	Job costing	£300	P1
	Letter writer	£80	V1
	Mailing list	£50	D1
	Mailing list	£40	P2
	Mail shot	£225	P2
	Pad to plotter system	£250	P2
	Payroll	£375	V1
	Payroll	£200	P2
	Payroll	£375	C6
	Payroll	£10	D1
	Personnel records	£98	P2
	Production analysis	£75	P2
	Programming aids	£40	P2
	Purchase ledger	£315	V1
	Purchase ledger	£300	P1
	Purchase ledger	£295	P2
	Purchase ledger	£295	C6
	Sales ledger	£315	V1
	Sales ledger	£300	P1
	Sales ledger	£295	P2
	Sales ledger	£295	C6
	Salesman	£10	D1
	Statistics	£100-195	P2
	Stock control/recording	£285	V1
	Stock control/recording	£300	P1
	Stock control/recording	£35/98	P2
	Stock control/recording	£10	D1
	Time/cost recording	£300	P1
	Time/cost recording	£125	P2
	Utilities	£20	C6
	Word processing	£120	V1
	Word processing	£150-300	P2
	Word processing	£40	D1
	Word processing	£75	J1
Apple II/ ITT 2020	Database management/ information retrieval	£100	S4
	Estate agent	£750	S4
	Financial planning	£250	S4
	General ledger/NL	£250P	S4
	Mailing list	£100	S4
	Office admin	£100	S4
	Payroll	£250P	S4
	Purchase ledger	£250P	S4

PACKAGES

DIRECT ACCESS

Machine	Application	Price	Code
	Sales ledger	£250P	S4
	Stock control/recording	£500	S4
	Text file librarian	£125	S4
	Word processing	£180/95	S4
CBM	Bureau de change	£8	H3
	Estate agent	£30	H3
	General ledger/NL	£200	H3
	Mailing list	£35	H3
	Payroll	£10	H3
	Price lister	£12	H3
	Purchase ledger	£350	H3
	Sales ledger	£350	H3
	Stock control/recording	£35/25	H3
	Utility set	£78	H3
	VAT master	£25	H3
	Word processing	£35	H3
Commodore/ Computhink	Appointments planner	£100	S3
	Bank accounts	£100	S3
	Bonds/pension quotations	£100	S3
	Database management/ information retrieval	£45-250	S3
	Estate agent	£250	S3
	General ledger/NL	POR	S3
	Incomplete records	£750	S3
	Integrated accts	POR	S3
	Invoicing	POR	S3
	Mailing list	£100	S3
	Mail shot	£125	S3
	Petaid report generator	£125	S3
	PR/advertising package	£1000	S3
	Printers job control	£250	S3
	Purchase ledger	POR	S3
	Sales ledger	POR	S3
	Stock control/recording	£100/250	S3
	Time/cost recording	POR	S3
	Word processing	£120	S3
CP/M	Cash flow	£250	L3
	Company secretary	£450	C4
	Contract costing	£2000	L3
	Database management/ information retrieval	£150-750	C4
	Equipment lease/rent/ HP	£400	G1
	Estate agents	£750	C4
	Financial modelling	£400	G1
	General ledger/NL	£500	L3
	General ledger/NL	£500	C4
	General ledger/NL	£400	G1
	General ledger/NL	£500	K1
	General ledger/NL	£375	L1
	Integrated accts	£1500	C4
	Integrated accts	£1100	G1
	Integrated accts	£950	L1
	Invoicing	£325	L1
	Invoicing	£150-350	C4
	Invoicing	£500	K1
	Job costing	£700	C4
	Legal precedents	£1100	C4
	Mailing list	£50-150	C4
	Mailing list	£250	G1
	Mail shot	£200-360	G4
	Order entry/invoicing	£350	G1
	Order processing	£550	L1
	Payroll	£450	L3
	Payroll	£495	C4
	Payroll	£500	G1
	Payroll	£500	K1
	Payroll	£475	L1
	Personnel records	£450	C4
	Production analysis	£700	C4
	Property management	£450-1000	C4
	Purchase ledger	£500	L3
	Purchase ledger	£450	G1
	Purchase ledger	£500	K1
	Purchase ledger	£425	L1
	Purchase ledger	£500	C4
	Sales ledger	£500	L3
	Sales ledger	£500	C4
	Sales ledger	£450	G1
	Sales ledger	£500	K1
	Sales ledger	£425	L1
	S/L, P/L + stock control	£1000	L3
	Stock control/recording	£325	L1
	Stock control/recording	£500-1500	C4
	Stock control/recording	£350	G1
	Stock control/recording	£500	K1
	Time/cost recording	£400	G1
	Word processing	£500	K1
	Word processing	£400	G1
	Word processing	£150-260	C4
Cromemco	Database management/ information retrieval	£250	B3
	General ledger/NL	£250	B3
	Hire purchase	£400+	B3
	Integrated accts	£950	B3
	Invoicing	£100	B3
	Leasing	£400+	B3
	Purchase ledger	£250	B3
	Revolving credit	£400+	B3
	Sales ledger	£250	B3
	Stock control/recording	£450	B3
	Time/cost recording	£250	B3
ITT 2020	Bank account	£10	D1
	Cash register	£10	D1
	General ledger/NL	£295	C6
	Integrated accts	£450	P1
	Invoicing	£300	P1
	Job costing	£300	P1
	Mailing list	£50	D1
	Payroll	£10	D1
	Payroll	£375	C6
	Purchase ledger	£300	P1
	Purchase ledger	£295	C6
	Sales ledger	£300	P1
	Sales ledger	£295	C6
	Salesman	£10	D1
	Stock control/recording	£10	D1
	Stock control/recording	£300	P1
	Time/cost recording	£300	P1
	Utilities	£20	C6
	Word processing	£40	D1
MCZ Zilog	Budgeting package	£500+	I1
	Conference organiser	£500+	I1
	Mail shot	£200	I1
	Personnel records	£500+	I1
	Screen generator	£75+	I1
	Word processing	£500+	I1
MZ-80K	Integrated accounts	£150	P2
	Stock control/recording	£150	P2
North Star Horizon	Database management/ information retrieval	£250	B3
	General ledger/NL	£250	B3
	Integrated accts	£950	B3
	Invoicing	£100	B3
	Payroll	£350	B3
	Purchase ledger	£250	B3
	Sales ledger	£250	B3
	Stock control/recording	£450	B3
	Time/cost recording	£250	B3
PCC 2000 Simpelec Triton 3	Estate Agent	£350	B2
	General ledger/NL	£350	B2
	Mail shot	£450	B2
	Purchase ledger	£350	B2
	Sales ledger	£350	B2
	Stock control/recording	£350	B2
	Time/cost recording	£350	B2
PET	Bank account	£10	D1
	Cash flow	£8	A1
	Cash register	£10	D1
	Credit control	£650	B4
	Database management/ information retrieval	POR	C1
	Database management/ information retrieval	£325	A1
	Database management/ information retrieval	£225	H4
	Database management/ information retrieval	£170	C3
	Estate agent	£25	A1
	General ledger/NL	£1000	C1
	Invoicing	£350	A1
	Invoicing	£400	C1
	Lotteries	£45	H2
	Mailing list	£15	A1
	Mailing list	£50	D1
	Mailing list	£45	H2
	Membership accting	£85	H2
	Payroll	£50/195	I2
	Payroll	£10	D1
	Payroll	£50/25/ 195	A1
	Payroll	POR	C1
	Payroll	£200/350	C5
	Personnel records	£85	H2
	Purchase ledger	£95/120/ 350	A1
	Purchase ledger	£1000	C1
	Purchase ledger	£300	B4
	Sales ledger	£300	B4
	Sales ledger	£800	C1
	Sales ledger	£95/350	A1
	Salesman	£10	D1
	Stock control/recording	£195	I2
	Stock control/recording	£10	D1
	Stock control/recording	£12/25/ 350	A1
	Stock control/recording	£15	A2
	Stock control/recording	£300	B4
	TAP business system	£125	H2
	VAT	£17.50	A1
	Word processing	£40	D1
	Word processing	£85/65/ 40/20	H2
	Word processing	£375	H4
	Word processing	£25/325	A1
	Word processing	325	C5
PET/CBM	Assembler dev	£50	C2
	Database management/ information retrieval	£75	B1
	Database management/ information retrieval	£50/150	C2
	Database management/ information retrieval	£150	G2
	Database management/ information retrieval	£150	J1
	Disk operating system	£150	B1
	General ledger/NL	£200	C2
	Integrated accts	£300	B1
	Integrated accts	£(50)	C2
	Integrated accts	£650	G2
	Integrated accts	£650	J1
	Invoicing	POR	J1
	Invoicing	£25-50	B1
	Lisp	£75	C2
	Mailing list	£75	B1
	Pascal	£120	C2
	Payroll	£150	G2
	Payroll	£150	J1
	Payroll	£150	C2
	Petsoft programs	£160	J1
	Production analysis	£300	B1
	Purchase ledger	£200	C2
	Purchase ledger	POR	J1
	Sales ledger	POR	J1
	Sales ledger	£200	J1
	Stock control/recording	£150	C2
	Stock control/recording	£300	B1
	Stock control/recording	£150	G2
	Stock control/recording	£150	J1
	Time/cost recording	£300	B1
	Word processing	£75/150	J1
	Word processing	£75/150	G2
	Word processing	£75/150	C2
PET/ Computhink	Stock control/recording	£250	R1
PET/8032	Mailing list	£75/150	S1
	Planning maintenance	£595	S1
	Purchase ledger	£395	S1
	Sales ledger	£395	S1
	Solicitor's package	£750	S1
	Stock control/recording	£395	S1
	Vet package	POR	S1
	Warehousing	POR	S1
Sorcerer	Payroll	£250	L2
Tandy Model I	Database management/ information retrieval	£25-80	M1
	General ledger/NL	£90	M1
	Incomplete records	£40	M1
	Integrated accts	£350	M1
	Invoicing	£90	M1
	Job costing	POR	M1
	Mailing list	£40	M1
	Payroll	£249	M1
	Purchase ledger	£90	M1
	Sales ledger	£90	M1
	Stock control/recording	£30-50	M1
	Time/cost recording	POR	M1
	Word processing	£50/75	M1
Tandy Model II	CBasic	£70	M1
	CP/M + utilities	£150	M1
	General ledger/NL	£90	M1
	Integrated accts	£350	M1
	Invoicing	£90	M1
	Job costing	POR	M1
	Mailing list	£75	M1
	Mail shot	£75	M1
	Purchase ledger	£90	M1
	Sales ledger	£90	M1
	Stock control/recording	£300	M1
	Time/cost recording	POR	M1
	Word processing	£175-240	M1
TRS-80	Database management/ information retrieval	£60	S2
	Database management/ information retrieval	£32.50	H1
	Database management/ information retrieval	£150	J1
	General ledger/NL	£225	H1
	Incomplete records	£40	H1
	Integrated accts	£75	J1
	Investment portfolio	£20	S2
	Invoicing	£25	H1
	Mailing list	£25/38/ 55	H1
	Mailing list	£50-150	S2
	Payroll	£200	H1
	Purchase ledger	£225	H1
	Sales ledger	£225	H1
	Statistics	£45	S2
	Stock control/recording	£200	H1
	Stock control/recording	£48	S2
	Stock control/recording	£115	J1
	VAT register	£15	H1
	Word processing	£45/95	J1
	Word processing	£15	H1
	Word processing	£30/60/ 90	S2
TRS-80I	General ledger/NL	£225/325	T1
	General ledger/NL	£325	K1
	Individual designed programs	£100 up	K1
	Invoicing	£75	K1
	Invoicing	£75	T1
	Payroll	£218	T1
	Payroll	£218	K1
	Purchase ledger	£225	K1
	Purchase ledger	£225	T1
	Sales ledger	£225	T1
	Sales ledger	£225	K1
	Stock control/recording	£200	K1
	Stock control/recording	£200	T1
	Word processing	£70	K1
TRS-80II	General ledger/NL	£425	T1
	Invoicing	£125	T1
	Payroll	£375	T1
	Purchase ledger	£375	T1
	Sales ledger	£375	T1
	Stock control/recording	£375	T1
Vector	General ledger/NL	£400	C5
	Integrated accts	£1000	C5
	Purchase ledger	£400	C5
	Sales ledger	£400	C5
	Word processing	£40	C5
8000 Series	Database management/ information retrieval	POR	C2
	Integrated accts	POR	C2
	Payroll	£250	C2
	Purchase ledger	£250	C2
	Sales ledger	£250	C2
	Word processing	£250	C2
8080/Z80	General ledger/NL	£275	G3
	General ledger/NL	£375	L1
	Integrated accts	£950	L1
	Integrated accts	£995	G3
	Invoicing	£325	L1
	Job order control	£257	G3
	Order processing	£550	L1
	Payroll	£475	L1
	Payroll	£275	G3
	Prof appts groups	£275	G3
	Prof appts individ	£220	G3
	Prof client billing	£330	G3
	Purchase ledger	£425	L1
	Purchase ledger	£275	G3
	Sales ledger	£275	G3
	Sales ledger	£425	L1
	Stock control/recording	£325	L1
	Stock control/recording	£275	G3

TRANSACTION FILE

Because of the ever-increasing popularity of 'Transaction File', we regret that we cannot continue to offer a free service. So, all ads received after **30 April** *must be accompanied by a flat-rate* **£1** *handling fee; ads received before that date will be published free.*
Because of the current backlog, we cannot undertake to place ads in specific issues — all will be published in strict rotation. Our 50 words maximum limit and non-commercial restriction continue — ads from individuals selling software are classed as commercial and are not acceptable for 'Transaction File', which is a reader service for selling or buying on a one-off basis.
Send your ads (with £1) to: **Transaction File,** *PCW,* **14 Rathbone Place, London W1P 1DE.** *Crossed cheque or PO should be made payable to:* **Sportscene Publishers** *(PCW)* **Ltd.**

For sale

Apple accessories. . . Silentype £215; graphics tablet, £300; language system, £180; integer card, £65; Centronics card, £79; Eurocolour card (rev 3), £50; UHF modulator, £7; all as new. Tel: 01-898 6621.

TRS-80 L2 16k. . . with TV modulator, cassette, £200 software inc games & prog aids, offers around £425. Write R Hodgson, 103 Kingston Rd., Wiverley, Hull.

77/68 boards. . . fully socketted: CPU, £25; Mon 1, £35; 4k RAM, £40. Doc included. Tel: a Hay, 01-727 8147 after 7.

Nascom 2. . . Microtype model 3 case, £17.50; 16k RAM board modified for 4 MHz without wait states, £95. Tel: 0782 324639 eves.

1 set. . . of PET Basic 2 ROMs, £25. Tel: Ray, Leicester 374233.

UK101. . . 8k, case, Hyspec I/O int, Hyspec sound board, new & old monitors, assembler/editor, joystick, illuminated switch, software, £260 or negotiate. Tel: L Booth, Peterborough (0733) 268519.

Apple graphics tablet. . . £250; PC1008 printer for TI59 (unused), £75; stats module & manual, £10. Tel: Redcar (0642) 474707.

ZX80. . . 4k static RAM, PSU, manual, leads, perfect working order. Write 7 Blaise Close, Clifton Estate, Nottingham NG11 9BW.

TI58. . . prog calc, as new, boxed, manuals, £35. Tel: Richard, Welwyn Garden City 23505.

PET 8k. . . old ROMs, many progs, manual, 'PET Revealed', 1980 'Printout's, friendly advice if needed, £350 but will listen to any offers. Tel: Jonathan, 01-584 1359 after 6.

ZX80. . . factory built, perfect order, PSU & leads, Sinclair & Linsac manuals, £75 inc UK postage. Tel Cheltenham 74982 weekday eves.

Atari. . . video comp with Combat & Space Invaders, unwanted gift, £80 or p/ex with cash adjustment for 16/32k PET or TRS-80 L2. Tel: 01-863 3811 (eves), 01-600 6020 ext 242 (day).

380Z. . . 32k, twin floppies, lots of s'ware, unused, list price £2000+, offers. Tel: Birtley 403511 (day).

Printer. . . for Sharp MZ-80K. Adcomp X80 plain paper matrix printer, Sharp int, full Sharp char set inc graphics, 6 months old, little used, £275 ono. Tel 0635 63502.

KSR33 Teletype. . . just serviced, 20 mA, good cond, £145 + carr. Write: J Halfpenny, Girton Colleg college, Cambridge CB3 0JG.

UK101. . . 8k, prof built, cased, leads, progs in Basic & m/c code, £230. Tel: 01-300 7633 after 5.

ZX80. . . checked by SoC, leads, manual, PSU, as new, £70. Tel: Welwyn Gdn City 27964.

8k PET. . . green screen, old ROM ROM, Petunia Player board, manuals, cover, £330. Tel: Reigate (07372) 48633.

TRS-80 16k L2. . . with VDU, cass, numeric keypad, latest model, much s'ware, £450 ono. Tel Hythe (Kent) 65650.

TRS-80 32k L2. . . with VDU, num pad, 2 disk drives, Centronics 779 printer (tractor feed), L2 & disk manuals, Newdos Plus, Sargon chess, many other progs on disk, £1400. Tel Lea Valley 714209.

TRS-80 4k L1. . . with VDU, cass, tapes, 2 months old, offers c. £325. J Reid, 51 Shore Rd. Warsash, Southampton S03 6FS.

Apple II. . . Eurocolour card A2B0017 (the new one), unused, £95. Joystick paddle control, unused, £25. Tel: J Rigden, Diss (0379) 3222.

6550 memory chips. . . for PET, small number, all a year old but little used, £5 each. Tel: 0204 50920 w/ends.

PET 16k. . . new ROM, large kbrd, cass, toolkit, sound box, Strathclyde Basic course, PET m/c lang guide, £120+ worth games s'ware, £520 the lot. Tel: John, 0626 82315 eve or w/ends.

MK14. . . new monitor, extra RAM, RAM I/O chip, PSU, cass int, add-on kbrd, single-step facility, manual, data sheets, £70 ono. Tel: 0455 282770 after 6.

Nascom 2. . . 16k, prof built, Microtype case, PSU, graphics chip, Nas-Dis, Nas-pen, Basic Toolkit, full doc, cost £650, want £525 ono. J Cooper, 23 Cemetery Hill, Hemel Hempstead. Tel: 01-930 5432 (day).

ZX80. . . built, inc PSU, leads, manual, 28 progs on cass, ex cond, £80. Tel: J Prior, Stamford (0780) 720595.

ZX80. . . factory built, perf cond, all leads, manual, book of 30 progs, £79. Write M Sparks, Flat 1, 13 St Ursula Grove, Southsea, Hants PO5 1LT.

SWTP PR40. . . printer, £60; Motorola 6800 D2 system with s'ware & additional firmware, £75; SWTP AC30, £6. Tel: Kings Langley 64172.

Dolphin DB80. . . 80-col printer, serial & parallel ints, extra 2k buffer, exc cond, spare ribbon & paper, cost £700, accept £500 ono. Tel: 0235 25287.

PET 16k. . . green screen, large kbrd, cass deck, some games, £500. Tel: Bryan, 01-552 6026.

Olivetti TE318. . . send/receive terminal, working, £140. Tel: Aylesbury (0296) 630617.

48k ITT 2020. . . 6 months old, manuals, paddles, games, offers around £650. New DOS 3.3 ctrller card & s'ware, £50. Tel: Clive, 01-200 7435 eves.

Tandy quick printer II . . . 16 & 32 chars/line, paper, cable for L2 TRS-80, manual, orig packing, £95.

Teletype ASR33. . . tape punch, reader, parallel int, service manuals, spare ribbons, exc cond, £300. Write 24 College Rd, Brighton, tel Medway (0634) 33621.

TRS-80. . . pocket comp, cass int, still under warranty, inc full year sub to users club, £125 inc post. Tel Graeme Silverwood, Barnsley 294189 eve.

Acorn Atom. . . built, exp to 12k + 8k ROM, leads, manuals, PSU, £220 ono. Tel: Dave, 051-920 8195.

Superboard II. . . 4k RAM, cased, integral PSU, 2 months old, as new, tapes & books etc, around £240. Tel: Wakefield 270584.

Centronics quick printer. . . brand new, inc 3 spare rolls paper, £185 ono. Printer int for TRS-80, £30 ono. Some s'ware & books for TRS-80, offers. Tel: Seaford (0323) 891755.

TRS-80 L1 4k. . . inc VDU, cass, games tape, manuals, boxed, year's sub to L1 User Group, £280. Tel: Stanford-le-Hope 2077.

Euroapple 48k. . . disk drive, cntrl card, int card, colour card, parallel printer card, col TV set, approx 2 months old, will deliver in London, £1600 ono. Tel: Paul, 01-876 0521.

VDU kbrd unit. . . Elekterminal PCB, 16x64, cased, £50. Expanded Superboard II, 32x48 display, Cegmon monitor, 9" green screen, RS232 int, 6 A PSU, cased, manuals, some s'ware, £450. 14" TV modded as monitor, can be used as either, £40. Tel: Pawley, 01-751 2262 after 7.

ZX80. . . complete, Sinc built, working, manual, '30 Progs', 'Magic', 'ZX80 Companion (2nd)', 'Personal Computing' books, 10 new cassettes. Cost £150, sell £85+ post or buyer collects. 14 Hillview, Saunderton, High Wycombe, Bucks. Tel: Naphill 2966 eves.

77-68. . . CPU board, Mon1, VDU brd, PIO brd, 4k static & 16k dynam RAM, fully decoded ASCII kbrd, cass int, backplane, case, 10 A PSU, s'ware inc Basic & assembler, £225 ono. Tel: 01-863 7512.

ZX80. . . 2 months old, never used, leads, adaptor, manual, £70. Petsette, 20 progs for PET, never used, £12. Tel: Mark, Slough 45380 eves.

ZX80. . . 1k RAM, working but needs attn to video display, inc leads, PSU, manual, £60. Tel: Newton Abbott (0626) 3466.

Centronics 779. . . dot matrix printer, pinch feed, hardly used, £750. Tel: 0922 684643 eves.

Powertran Comp 80. . . MkIII monitor, 4k RAM, cass player, reident Basic, s'ware, manual, other extras inc Base 2 matric printer, will split, £580. Mr T Baggaley, Flat 2, 1 The Crescent, Retford, Notts. Tel: 705717.

T159. . . prog calc, master module, mag cards, wallets, manuals, coding sheets, case, boxed, 2 months guarantee, £90. Tel: Huddersfield (0484) 23127.

8k 2001 PET. . . old ROM, small kbrd, perspex green screen, soundbox, progs, toolkit, manuals, £325 ono. Tel: Ipswich (0473) 50524 eves or w/ends.

TRS-80 16k L2. . . numeric keypad, almost new, manuals, leads, tapes, packing, £345 ono. Tel: Bath (0225) 319237 eves.

Fidelity. . . Voice Chess Challenger, as new, £110. S Coleby, 25 Parsonage Manorway, Belvedere, Kent, tel Erith 45782.

TRS-80 L1 4k. . . green screen, cass deck, 3 months old, £230 ono. Tel: Helsby 5774 after 6.

PET Basic. . . 2 ROMs, £30; 16 4108 dynamic RAMs, £25 (from PET); PET Pascal, inc disk, manual & chip, £70; CBM Wordpro III, £50; all ono. Tel: John, Oxford 53391 ext 215, weekdays.

TRS-80 L1 4k. . . green screen, monitor, CTR-80 cass rec, manual, 10 months old, guarantee still left, Basic instruction tapes, games pack & Microchess, £320 ono. Tel: 0792 781306.

ZX80. . . 4k RAM, PSU, manual, leads, excellent working oder, £95. Tel: Steve, Witham 514884 eves.

Triton. . . prof built, L6.1 monitor, 4k on-board RAM (1k video), separate cased keyboard, oscillator, autorepeat, 64 graphics characters plus memory-mapped display, £220 ono. Tel: Pete, Coventry 0203 613156 eves.

Epsom TX-80. . . printer with tractor feed, 6 months old, £250 ono. Tel: Farnham 725677.

UK101. . . cased, tested, 8k, new monitor, games tapes inc Space Invaders, Motorola 9in CRT (cased), cass rec (new), leads, documentation, vgc, no snags, ready to run, £460 six months ago, sell for £340. Tel: Ian, 01-903 4311 after 6.

ZX80. . . assembled, PSU, manual, leads, ready to run, £70. Tel: 0493 63754 after 11 am.

PET 8k. . . old ROM, small keys, AY-3-8910 sound chip, Stuart micrographics colour mod + data & int (not connected), ext small keys, 70 progs (games/tutorial) with some data sheets, £400 no offers. Who wants to swap progs (PET old ROM) with me. Tel: 01-840 3610.

Wanted

TRS-80. . . quality printer, disk drive, s'ware, req by new user. Tel: Bishop's Stortford (0279) 813069.

TRS-80. . . or kit, used or new. Payment takes the form of 15 days — 1 month in a new flat (3—4 persons) on beach 15 mins from Faro airport, Algarve, Portugal, depending on season/value of computer. F Garcia, Apart 1355, 1011 Lisboa CODEX, Portugal.

KIM system. . . with Basic, anything considered, Write Bruno Hewitt, 1 Kempsford Gdns, London SW5 9LA.

ZX80. . . Sinc built, with all leads, manual, PSU. Michael Woodridge, The Orchard, Millway, Sutton St Nicholas, Nr Hereford, tel (0432 72) 244.

Integer. . . formware card for Apple. Tel Dave, 061-747 8383.

Acorn Atom. . . or other comp in £100-£200 range. Tel: Mr Page, York (0904) 22716.

Manuals. . . &/or other info on Friden Flexowriter. David Senior, 22 Embden Ct, Denmark Rd, Manchester M15 6NE. Tel: 061-236 4612/0011 day/early eve.

PET. . . 8/16/32k, large kbrd, new ROM, pay up to £400. Tel: Mike, Nazeing 3654.

PCW. . . Vol 2 Nos 5 & 6, in good cond, any price considered. Tel George Jack, 01-848 0020 or 01-868 4411.

NETWORK NEWS

Here are the details of additions and changes recently notified. If we have failed to include YOUR group (or have published incorrect information) either here or in the complete listing, then please address changes/additions to: PCW (User Groups Index), 14 Rathbone Place, London W1P 1DE. Finally, the next complete listing will appear in our May issue.

Forum 80. . . operated by Frederick Brown, tel: Hull (0482) 859169. No access charge, open to any micro owner. Operating Tues & Thurs 1900 — 2200, Sat & Sun 1200 — 2200. Facilities: bulletin board, program library for downloading programs (all in Microsoft Basic), program uploading for adding your own progs to library; Forum 80 Users Group (membership free) enables access to programs not in public domain.

National TRS-80 Users' Group. . . being set up at time of writing, will be available to all micro users, not just TRS-80 owners. Initially access charge will be a £10 sub, but as more join, this will be reduced and refunds made accordingly. Facilities: bulletin board & programs for downloading. Contact: Brian Pain, tel 0908 566660 (office).

FEATURE INDEX

Here is a complete index to the current volume of *PCW* (up to and including last month). Full indexes to previous volumes were published in March 1980, April 1980 and January 1981. A quick guide to available back issues is given below.

BACK NUMBERS

Volume 1 No. 1
May 1978
Nascom 1/77-68: The Mighty Micromite/A charity system.

Volume 1 No. 2
June 1978
Research Machines 380Z/Computer in the classroom/The Europa Bus.

Volume 2 No. 1
May 1979
Small computers for small organisations/ Sorcerer graphics/Chess Programming Hints/ Parkinsons Revas.

Volume 2 No. 2
June 1979
MSI 6800/Witbit — disassemble your programs/The Multilingual Machine/Polytechnical Processing.

Volume 2 No. 4
August 1979
The North Star Horizon /High Speed Cassette Interface for the SWTP 6800/Garage Accounting program/Apple Medical Application.

Volume 3 No. 5
May 1980
Benchtests — TI 99/4, Altos ACS-8000-2, HP-85/West Coast Faire report.

Volume 3 No. 6
June 1980
Benchtests — TRS-80 Model II, Periflex 630/ 48/Stringy Floppy Checkout/Compucolor Case Study.

Volume 3 No. 9
September 1980
Benchtests — BASF 7120, CBM 8032/Hi-Tech Colour Board Checkout/Portable Basic.

Volume 3 No. 10
October 1980
Benchtests — DAI Personal Computer, Atari 400 and 800/ Robotics/3D Graphics/ Program 'Tuning'

Volume 3 No. 11
November 1980
Benchtest — SBS 8000/ComputerTown UK! — Community Computer Literacy Project/Apple Colour Graphics.

Volume 3 No. 12
December 1980
Benchtest — Raannd SP1/Pascal Micro-Engine/Microwriter Checkout/Micro-based Toys Review.

Any one issue 95p; Any two issues £1.75; Any three issues £2.50; Any four issues £3.00. All additional issues @ 50p each. Binders @ £2.95. All prices include post and packing. Cheque or P.O. payable to *(PCW)* Sportscene Publishers Ltd., 14 Rathbone Place, London W1P 1DE. Please allow up to 3 weeks for delivery and don't forget to state clearly your name and full address with your order. Please send me the following copies of *PCW*. I enclose a cheque/P.O. for £_____ Please tick appropriate boxes.

Volume 1	Volume 2	Volume 3	Volume 4
1☐ 2☐	1☐ 2☐ 4☐	5☐ 6☐ 9☐ 10☐ 11☐ 12☐	1☐ 2☐ 3☐ 4☐ 5☐ 6☐

Name_____ Address_____

USER GROUPS INDEX

As promised, here is a complete printout of our User Group Index. If we have failed to indicate YOUR group, then please address the relevant information to PCW (User Group Index), 14 Rathbone Place, London W1P 1DE. Notification of changes will also be appreciated. The next full listing will appear in PCW's August edition. In the meantime we shall of course continue to publish User Group Index update information — as and when it reaches us.

INTERNATIONAL

Tangerine Users Group (International). Recently formed for users of the Microtan 65, the TUG will act as a central information clearing house, including exchange of programs etc. Annual membership is £5.00. Details from TUG at 3/22 Donoughmore Road, Boscombe, Bournemouth, Dorset, UK.

USCD System User Society. Set up in San Diego in June for users of USCD Pascal, the society aims to establish a software library, promote regional and special interest group activities and liase with USCD system distributer Softech on future development plans. Existing special interest groups include industrial application, word processing, real time, business applications and forward planning. UK contact: John Ash, Dicoll Data Systems Ltd., Bond Close, Kingsland Estate, Basingstoke, Hants RG24 0QB.

European Sorcerer Club. New name for SPEC (Sorcerer Program Exchange Club). Not confined to Europe, in fact, as 200-strong membership includes people from all over the world. Publishes newsletter 10 times a year. Annual sub: British Isles £5; Europe £7; Overseas £12. Contact: Colin Morle, 32 Watchyard Lane, Formby, Nr Liverpool L37 3JU, tel: 070 48 72137.

Microcomputer Users Club: recently established for program writing and exchange, emphasis on 6502/Z80 users. Contact c/o Synthetronics Microcomputers P.O. Box 151, 1322 Hoevik, Norway.

Group/380. Recently established for information interchange on microsystems equivalent to IBM 360/370 main frames. Group expects to see several desktop 370 systems available in next few years; services offered include newsletter on hardware & systems developments and read/write postal access to a computerised database listing relevant software from the large volume of existing 360/370 software which will eventually be of use to users of micro 360/370-equivalent systems. Annual sub: $10 for individuals, $25 for organisations. Contact: Mokurai Cherlin, PO Box 1131, Mount Shasta, CA96067, USA.

NATIONAL

Amateur Computer Club. National organisation with several local groups which hold their own meetings and talks. *Accumulator* newsletter issued bi-monthly; software libraries for 6800, Z80 & 6502 processors available. Contact: Jim MacDonald, 1 Carlton Court, Studley Grange Rd, London W7 2LU.

11s Users Group. A sort of help service only. No meetings no newsletter. Contact: Pete Harris, 119 Carpenter Way, Potters Bar, Herts, EN6 5QB. Tel: 0707 52091 or 01-248 8000 Ext. 7065.

The 6502 Users Club. Hoping soon to hold regional and national meetings, they offer "support, encouragement and fellowship". Contact: Walter Wallenborn, 21 Argyll Ave., Luton, Beds LU3 1EG.

77/68 Users Group. Quarterly Newsletter. Free membership for 1st year if you buy the 77/68 instruction manual, £1.50 thereafter. Contact: Newbury Computing Store, 40 Bartholomew St., Newbury, Berkshire.

9900 Users Group TIMUG. Contact: Chris Cadogan, 21 Thistle Downs, Northway Farm, Tewkesbury, Glos.

Amateur Computer Club — 2650 Library. No meetings, no newsletters, the library serves to act as a help point for disseminating 2650 related data on demand. Contact: Roger A. Munt, 51 Beechwood Drive, Feniscowles, Blackburn, Lancs BB2 5AT (0254 22341).

Minicomputer Users in Secondary Education (MUSE). MUSE is the national organisation for coordinating activity in schools, teacher training institutions, colleges of technology and so on. Meetings are held on both a regional and national basis. For full details on MUSE's range of activities, contact the Treasurer, R. Trigger, 48 Chadcote Way, Catshill, Bromsgrove, Worcestershire.

UK Intel MDS Users Group. Contact: Lewis Hard, 29 Chaucer Rd., Bedford.

Ithaca Audio S100 bus UK User Group. Contact: Dave Weater, 16 Etive Place, Cumbernauld, Glasgow 067 4JE. Phone 02867 36570.

MK14 Club. Bi-monthly magazine called "Complement and Add". Contact: Geoff Phillips, 8 Podsford Rd., London NW9 6HP.

Independent PET users Group. Contact: IPUG, 57 Clough Hall Road, Kidsgrove, Stoke-on-Trent, Staffs.

Research Machines Ltd. National User Group. Contact: M.D. Fischer, PO Box 75, Oxford, OX4 1EY, for a registration form.

UK Apple Users Group. Contact: (Keen Computers) 5 The Poultry, Nottingham. Tel: 0602 583254/5/6.

Central Program Exchange. Full membership (£25 Europe, £40 overseas) provides 30 free programs p.a. Small User Service (£10 Europe, £20 overseas) provides 10 free programs p.a. Contact: Mrs Judith Brown, The Polytechnic, Wilfruma St., Wolverhampton, WV1 1LY.

Cosmac Users Coub (proposed) For people using the RCA 1802, Cosmac ELF, ELFII, Super ELF etc. Those interested contact James Cunningham at 7 Harrowden Court, Harrowden Road, Luton LU2 0SR (enclosed sae, please).

National TRS-80 Users' Group. Activities include a computerised bulletin board service (see 'Network News'). Contact: Brian Pain, National TRS-80 UG, 40A High St, Stony Stratford, Milton Keynes, tel (0908) 566660 (office), 564271 (home).

ZX80 Users Club. The group's aim is to create and share software which will fit within the machine's 1K RAM. Membership is free and first move will be to distribute a newsletter. Address to write is: 44-46 Earls Court Road, London W8 6EJ.

Ohio Scientific UK User Group. Independent of OSI, an important role will be the disentangling of poor documentation. There will be regular newsletters and membership is at present £5 per year. The group will initially be concerned with the practical aspects and applications of OSI systems — rather than with games. Contact Tom Graves at: 19a West End, Somerset, BA16 0LQ.

UK Pet Users Club. Contact: Commodore Systems Division, 360 Euston Road, London NW1 3BL.

British TI Users' Club. A loose association of owners and users of Texas Instruments programmable calcs, the club exists for the purposes of information and program exchange (and is in no way sponsored by TI). The main activity is production of a (roughly) monthly newsletter and membership costs £5.50. Details from 2 Woodside Crescent, Clayton, Newcastle-under-Lyme, Staffs ST5 4BW.

ZX80 Users Club. Bi-monthly newsletter. Low cost software. Technical support. Subscription £6 (UK), £10 (overseas). Contact: D. Blagden, PO Box 159, Kingston upon Thames, Surrey, KT2 5UQ. (s.a.e. for further information).

COMP 80 Users Group. Monthly newsletter. Annual subscription £5. Contact: Philip L. Probetts, 50, Cromwell Road, Wimbledon, London, SW19 8LZ.

National Personal Computer Users Association. Full membership now costs £8.00, but you'll receive a free datasheet of special routines for the UK101/Superboard on enrolment (routines include a fast Basic line renumberer only four lines long). For detail details send an SAE to: The Secretary, NPCUA, 11 Spratling Street, Manston, Ramsgate, Kent.

Powertran Users Club. Annual subscription £5.00, which includes a monthly newsletter. Contact Mr P L Probetts, 50 Cromwell Road, Wimbledon, London SW19 8LZ.

Acorn Atom User Group. Set up for interchange of software & hardware tips. Membership costs £4 pa inc. access to program library & free newsletter. Group supported by but independent of Acorn Computers. Contact: T G Meredith, "Sheerwater", Yealm View Rd, Newton Ferrers, S. Devon.

National T158/59 Club: bi-monthly newsletter, program exchange etc. Annual sub £5.50 or, if you include a program with your cheque then it's £3.50. Contact: R M Murphy, Dept. of Electronic Engineering, University College Swansea, S. Wales.

Sharp User Group: Sub £3. p.a., inc newsletter and free Space Invaders cassette for MZ-80K. Contact: Knights TV & Computers, 108 Rosemount Place, Aberdeen. Tel 0224 630526.

TRS-80 Level 1 User Group. For all Level 1 users. Qtrly newsletter containing s/ware (also avail. on cassette). £3 p/a for newsletter, or £7 p/a for news & cassette. Contact (with SAE): N Rushton, 123 Roughwood Drive, Northwood, Kirkby, Merseyside L33 9UG.

CP/M Users' Group (UK). Annual sub £5. S/ware library, newsletter, 'help' service. Contact: 11 Sun St, Finsbury Sq, London EC2M 22D.

British Apple Systems User Group Group. For Apple II and ITT 2020 users. Meets 1st Tues eve & 3rd Sun afternoons monthly at The Old School, Branch Rd, Park St, St Albans (on A5 about 2 miles south of city centre). Contact: John Sharp, Garston (09273) 75093 or David Bolton, Park Street (0727) 72917.

Anyone interested in forming a Texas T199/4 Users' Club with a magazine and a software library, should contact Mr P Dicks, Data Processing Manager, Pershke Price Service Organisation Ltd, Dover House, 141 Morden Rd, Mitcham. Surrey CR4 4XB, tel. 01-648 709 7090.

Sharp PC-1211 Users' Club. Also open to TRS-80 Pocket Computer owners and anyone else with or without a computer. Membership costs £5 p/a which includes a newsletter containing programs etc. Contact: Jonathan Dakeyne, 281 Lidgett Lane, Leeds LS17 6PD.

Sharp MZ-80K Computer Users' Club. Membership free, access to large user-written software library (Basic & machine language), meetings & newsletters. For details send SAE to Paul Chappell, Yeovil College, Golderoft, Yeovil, Somerset BA21 4AE.

FX500-P Users Association (proposed). For Casio FX 501-P & FX 502-P users to exchange ideas, tips, programs etc. If interested send SAE to Max Francis, 38 Grymsdyke, Gt Missenden, Bucks HP16 0LP.

British Amateur Robotics Association. Recently formed for anyone interested in robotics. Membership free but small production charge for newsletter. Contact: D Stocquelef, 66 Waterloo Rd, Penylan, Cardiff, S Glam.

UK Pilot User Group. Send an A4-size SAE for fact sheet on various Pilot versions available. Common Pilot Reference Manual available for £5. Versions of Pilot available for different machines. Contact: Alec Wood, Wirral Grammer School for boys, Cross Lane, Bebington, Wirral, Merseyside L63 3AQ.

TRS-80 Medical & Laboratory Users' Newsletter. Free quarterly newsletter detailing members' interests, programs & applications. Send SAE & details of interests to: Dr N Robinson, The Residency, Northwick Park Hospital, Harrow, Middx.

SOUTH

Southern Users of PETs Association. Free membership, meet first Wed. each month. £1.50 for monthly newsletter. Contact: 42 Compton Road, Brighton BN1 5AN.

NORTH-EAST

North-East RML 380Z Users' Group. Meets monthly at Micro-Electronics Education Centre, The Polytechnic, Newcastle upon Tyne. Contact: M Hatfield or R Reed, Computer Unit, Northumberland Building, The Polytechnic, Newcastle-upon-Tyne NE1 8ST, tel: 26002 ext. 268 (office hours).

NORTHWEST

Manchester Computer Club (formerly the Amateur Computer Club (Northwest Group)). Meets 1st & 3rd Thursdays monthly at St Peter's Chaplaincy, Precinct Centre, Oxford Rd, Manchester. Contact: David Wade, 28 Hazel Rd, Altrincham, Cheshire WA14 1JL, tel: 061-941 2486.

TRS 80 — North West Group. Subscription £5. Newsletter £3 (for 6 issues). Meetings last Wednesday monthly (not Dec) at the Stag Hotel, Carswood, Nr. Wigan. Contact: Melvyn D. Franklin, 40 Cowlees, Westhoughton, Bolton, BL5 3EG. Tel: 0942 812843.

Northwest Computer Club. Fortnightly meetings, 25p attendance fee. No subscriptions. Contact: John Lightfoot, 135, Ashton Drive, Frodsham, Warrington, Cheshire, WA6 7PU. Tel: 0928-31519.

ACC (Merseyside 380Z Users Group). Contact: Alan Pope, Paal Enterprise, 37 Stuart Road, Crosby, Liverpool L23 0QE.

USER GROUPS INDEX

Anybody in the Warrington area interested in forming a Mattel Intellivision TV Game group to organise meetings, competitions and lay foundations for the forthcoming computer addition? Tel Warrington 62215 after 4 pm.

IRELAND

Computer Education Society of Ireland. A voluntary organisation that consists of a national body and an expanding number of local branches. Their brief is to monitor computer education in Ireland.*National CESI* (£3 p.a.) — Dairmuid McCarthy, 7 St. Kevin's Park, Kilmacud, Blackrock, Co. Dublin. *Cork branch* (£1 extra) — Michael Moynihan, Colaiste an Spioraid Naomh, Bishopstown, Cork. *Dublin branch* (£1.50 extra) — Jim Walsh, C.B.S. Naas, Co. Kildare. *Limerick branch* (£1 extra) — Sr. Lourda Keane, Convent F.C.J., Laurel Hill, Limerick. *Waterford branch* (£1 extra) — Mr. Hugh Dobbs, Newtown School, Waterford. *Kilkenny branch* (£1 extra) Sr. Helen Lenehan, Presentation Secondary School, Kilkenny.

WALES

Gwent Amateur Computer Club. Covering the Gwent and Cardiff areas, the club has its own computer room and technical library. Meetings are held once a week on Wednesdays at 10 Park Place, Newport. Contact Ian Hazell on 0633 277711 (office hours).

SCOTLAND

The Grampian Amateur Computer Society. They meet every 2nd Monday of the month at the Holiday Inn, Bucksburn, Aberdeen and there's a monthly newsletter. For more details, contact M. Basil, Orton Cottage, Burnside, Lumphanan, Kincardineshire, Grampian Region (033 983 284).

Central Scotland Computer Club. Meets first and third Thursdays each month at Falkirk College of Technology, Grangemouth Rd, Falkirk. Contact J Lyon, 78 Slamannan Rd, Falkirk FK1 5NF, tel. 22430.

Crampian Amateur Computer Society. Meets second Monday monthly at local hotel, looking for own premises. Sub £4 p/a (£1 for junior members), monthly. About 50 members. Club owns an ICL 1902! Contact: Alan Hird, 20 Harcourt Rd, Aberdeen, Grampian, tel (0224) 33102.

AVON

Bristol Computing Club, £3.00 p.a. Meetings 3rd Wednesday, monthly. Contact: Leo Wallis, 6 Kilbirnie Rd., Bridge Farm Estate, Bristol, BS14 0HY. Tel: Bristol 832453.

BAUD (Bristol Apple Users and Dabblers). Contact: Geoff Smythe, Datalink Microcomputer Systems Ltd, 10 Waring House, Redcliffe Hill, Bristol BS1 6TB, tel (0272) 213427.

Brunel Technical College Computing Club. The club divides into two sections. . . the "skilled" and the "not skilled". They share alternate Wednesdays at the College. Contact: S.W. Rabona at 18 Castle Road, Worle, Weston-Super-Mare, Avon, BS22 9JW (0934 513068).

Compukit User Club. Details, contact P. Crabb Esq., 21 Jones Close, Yatton, Avon (0934 834808).

BERKSHIRE

The Thames Valley Amateur Computer Club. Meetings are on the first Thursday of every month and from November on, that will be at "The Southcote", Southcote Lane, off the Bath Road, Reading, Berks. Starting time, 7.00pm. Contact: Brian Quarm (Camberley 22186) OR Brian Steer (Slough 20034).

BUCKS

Would anyone interested in setting up an Apple Users Group in the Bucks/Berks area contact: Steve Proffitt, Tel: 01-759 5511 ext 7298 (day), or Marlow 73074 eves or w/ends.

CAMBRIDGESHIRE

Peterborough Computer Club. Recently formed, eets on first and third Mondays each month at Adult Education Centre, Brook Street, Peterborough. Contact: T Marchant, tel Peterborough 76681 after 6 weekdays, anytime weekends.

CLEVELAND

Cleveland Micro Computer Users Group. Adult Meetings 3rd Tuesday monthly, under 18s — 2nd Tuesday. Yearly subscription £2 (18), £3 (18-21), £5 (21+). Journal. Contact: J. Telford, 13, Weston Crescent, Norton, Cleveland.

CORNWALL

Cornish Computing Club. Recently formed by members of the Cornish Amateur Club. Meets 7.30pm 3rd Monday monthly at the SWEB Social Club, Pool, on A30 between Redruth & Camborne. Contact: Richard Frost, Trecarne, Alexandra Rd, Illogan, Redruth TR16 4EA.

Anyone interested in forming a computer club in Cornwall, catering mainly for PET, ZX80 and UK 101 computers should contact: M F Grove, 35 Causeway Head, Penzance, Cornwall.

DERBYSHIRE

Derby Microcomputer Society. Meets fortnightly at Derby Lonsdale College of Higher Education, Uttoxeter Rd, Derby at 7pm. Contact: Mike Riordan, 172 Blagreaves Lane, Littleover, Derby, tel (0332) 769440.

Derby & District branch of IPUG meets second Thursday each month. Contact: Raymond Davies Davies, 105 Normanton Rd, Derby DE1 2GG.

DEVONSHIRE

Exeter and District Amateur Computer Club. General meetings 2nd Tuesday monthly, specialist meetings 3rd or 4th Tuesday. £5.00 p.a. Contact: Doug Bates, 3 Station Road, Pinhoe, Exeter, Devon.

Plymouth and District Amateur Computing Club. Subscription £5.00 p.a. Meetings last Wednesday monthly. Contact: Keith Gould, c/o JAD Ltd., 21 Market Ave., Plymouth 62616 or 2 Brook Rd., Ivybridge 2399.

DORSET

Bournemouth Area Computer Club. Meets monthly at the Kinson Community Centre. Contact: Peter Hills, 54 Runnymeade Ave, Bournemouth, Dorset BH11 9SE, tel Northbourne 6547.

COUNTY DURHAM

Computer Club. Business & Word Processor section meets Fridays 7.30, Scientific & Recreational Saturdays 10.00. Contact: L. Boxell, 8 Vane Terrace, Darlington. Tel: 0325 67766.

Northeast PETS. Contact: Jim Cocallis, 20 Worcester Road, Newton Hall Estate, Durham. They meet the 2nd Monday of each month for software tuition and the 3rd Monday for hardware tuition (both in addition to normal activities). They start at 7.00pm and meet in the PET Lab, Newcastle Polytechnic, Ellison Building, Newcastle upon Tyne.

EAST ANGLIA

Anglia Computer User Group. Contact Jan Rejzl, 128 Templemere, Sprowston Road, Norwich NR3 4EQ.

EAST MIDLANDS

The East Midlands Independent TRS-80 Users Group now has to charge for its newsletter. Send 50p for Issue 4 (balance credited to your account). Contact: Mike Costello, 17 Langbank Avenue, Rise Park, Nottingham NG5 5BU.

ESSEX

TRS80 User Club (Chelmsford). Now part of the National TRS80 User Club. Contact: Michael Dean, 22 Roughtons, Galleywood, Chelmsford, Essex.

The Colchester Microprocessor Group. Meetings held at the University of Essex on the second and fourth Wednesdays of each month — 7.30 pm start. Membership is open to all, on payments of £5 annual sub (£1 for full-time students). Contact: the Information Centre at the University on the evening of the meeting.

Compukit User Club. Details, contact Adrian Waters, 117 Haynes Road, Hornchurch, Essex RM11 2HX (Hornchurch 40490).

Springfield Computer Club. Special interest in Sorcerer but beginners and others welcome. Meetings 1st Friday monthly. Contact: Stephen Cousins, 1, Aldeburgh Way, Springfield, Chelmsford, Essex CM1 5PB. Tel: 0245 50155.

South East Essex Computer Society. Meets monthly at the Southend-on-Sea College of Technology, has access to the college's micros, and is open to anyone over 14. Contact: R Knight, 128 Lt. Wakering Road, Lt. Wakering, Southend-on-Sea, Essex. Tel: Southend 218456.

GLOUCESTERSHIRE

Cheltenham Amateur Computer Club. Meetings, 4th Wednesday monthly, 7.30pm start. Contact: Mr. M. Pullin, 45 Merestones Drive, The Park, Cheltenham, GL50 2SU (Cheltenham 25617).

HAMPSHIRE

Southampton Amateur Computer Club. Meets 8 pm 2nd Wed each month (not July — Sept) at Medical Science Building, Bassett Cres. East, Southampton. £3 pa, OAP, & students £2. Newsletter & special int. groups; 2 yrs old, 80 members soon setting up another club in Portsmouth area. Contact: P G Dorey, Dept Physiology, The University, Southampton SO9 3TU or Andy Low, Tel: (0703) 555 605 ext 34.

HERTFORDSHIRE

Harpenden Microprocessor Group. They hold meetings every fortnight, cover a wide range of interests and attract members from the area around Luton, St. Albans and Welwyn. Contact: David James, 5 Ox Lane, Harpenden, Herts AL5 4HH (05827 5366).

ISLE OF WIGHT

IoW TRS-80 Users Club: Meets each Friday at 8 pm at 72 Union Street, Ryde. Contact: Mr M R Collins, 3 Altofts Gardens, Ventnor, IoW.

KENT

MACRO (Medway Amateur Computer & Robotics Organisation). Meets monthly, sub £3. Contact: Mrs Christine Webster, 13 Ladywood Road, Cuxton, Rochester, Kent Tel: 0634 78517

North Kent Amateur Computer Club. Meetings, the second Tuesday of each month — usually at the Charles Darwin School, Jail Lane, Biggin Hill, Kent. The sub is £2.50 per annum (£1 for students). More members are needed. . . contact: Barry Biddles at 3 Acer Road, Biggin Hill, Kent (09594 71742).

LANCASHIRE

PET Users' in West Lancs. Meets monthly on third Thursday each month at Arnold School Blackpool. Contact: David Jowett, 197 Victoria Road East, Thornton, Blackpool FY5 3ST. tel Cleverleys 869108.

Merseyside Microcomputer Group. Several sub-groups including: 380Z User's Group (Alan Pope on 051-924 2470); Computer Education Society (Mr M. Trotter on 051-652 1596); SC/MP Special Interest Group (Bob Perrigo on 051-677 6716); PET Special Interest Group; 6800 and 77/68 Special Interest Group; Apple Special Interest Group. The Secretary is John Stout of the Dept. of Architecture, Liverpool Polytechnic, 53 Victoria Street, Liverpool L1 6EY (051-236 0598).

North Lancs User Group. Contact John Robinson, 12 Harold Ave., Blackpool, Lancashire.

Chorley Computer Club. PET-biased but owners of other (or no no) computers welcome. Meets informally on alternate Tuesdays in a pub in Chorley. Contact: Rod Wilson, tel Chorley 71875 or Chris Hicks, tel Chorley 78376.

LEICESTERSHIRE

The Leicestershire Personal Computer Club. Meetings held the 2nd Monday in each month, at Leicester University and Loughborough University alternately. They start 7pm. Membership is £2 per annum (£1 for under 16s). Contact: Miss Jill Olorenshaw (Club Secretary) c/o Arden Data Processing, Municipal Buildings, Charles Street, Leicester (0533 22255) OR Mr Dick Foden (Club Chairman) at 11 Gaddesby Lane, Rearsby, Leicester.

LINCOLNSHIRE

Lincolnshire Microprocessor Society. Various meeting places. For up-to-date information, contact the Hon Sec. Mr Eric Booth, Senior Common Room, Bishop Grosseteste College, Newport, Lincoln.

LONDON

TRS-80 Users' Group London Branch, recently formed and meet meets 2nd Friday each month 6pm, at 292 Caledonian Rd, London N1. Contact: J Wellsman, 01-607 0157.

Compucolor User Group, London area. Has contacts with both US and Canadian Compucolor user groups. Contact: Bill Donkin, 19 Harwood Ave, Bromley, Kent BR1 3DX.

380Z User Group, North London Branch. Includes Herts, Cambs, Oxon. Contact: Sheridan Williams, 35 St Julian's Rd, St. Albans, Herts AL1 2AZ.

West London Personal Computer Club. Meets first Tues. each month at Willesden Technical College. Also visits, special int. groups, demos, problem surgeries. Contact: Graham Brain, 81 Rydal Cres, Perivale Middx, Tel: 01-997 8986

Southgate Computer Club. The club recently held its AGM and adopted a formal constitution. Annual subscription will be £2.50 from January 1981, including a club newsletter; full-time students under 18 pay half-cost. The club now has 83 members. Contact: Panos Koumi, Southgate Computer Club, 33 Chandos Avenue, London N14.

East London Computer Club. Meets every Friday at 7.30 in term at North East London Polytechnic, Romford Rd Precinct, Stratford E15. Contact John Grieve, 01-533 4761.

The North London Hobby Computer Club General meetings held on a Wednesday evening, once a month — specialised topics on three evenings each week. Location: The Polytechnic of North London. Contact: Robin Bradbeer (Chairman) at the Dept, of Electronic and Communications Engineering, Polytechnic of N. London, Holloway, N7 8DB (01-607 2789).

USER GROUPS INDEX

SELMIC (South East London Microcomputer Club). Meets fortnightly at Thames Polytechnic. Annual sub £5. Contact: Peter Phillips, 61 Craigerne Rd, London SE3, tel 01-853 5829.

Croydon micro/small computer group. Contact Vernon Gifford, 111 Selhurst Road, London SE25 6LH.

East London Amateur Computer Club. Meets 7—10pm on 2nd & 4th Tuesdays monthly at Harrow Green Library, Leytonstone, London E11. Contact: Fred Linge Linger, 01-554 3288.

LONDON & SOUTH EAST

Sharp MZ-80K User Group. Contact: Joe L.P. Seet, 16, Elmhurst Drive, Hornchurch, Essex, RM11 1PE. Tel: 04024 42905.

Sunbury Amateur Computer Club Club. Meets 1st Friday monthly whenever possible, 20p per meeting. Contact: S Taylor, 8 Priory Close, Sunbury-on-Thames TW16 5AB, tel Sunbury 86649.

MANCHESTER

Atom Users' Group. Meets last Tues monthly during school terms at Abraham Moss Centre, Crescent Rd, Manchester 8. Contact: Clem Rutter, 061-434 3092 (eves).

MIDDLESEX

Sunbury Amateur Computer Club. Membership free. Contact Mr S N Taylor, 8 Priory Close, Sunbury on Thames, Middlesex. TW16 5AB. Tel: Sunbury 86649.

Harrow Computing Group. Meetings on alternate Wednesdays at 7pm in room G43 of Harrow College of Higher Education. They welcome anyone with an interest in computers — with or without a machine. Membership is free. For further information contact Bazyle Butcher, 16 St. Peter's Close, Bushey Heath, Herts WD2 3LG (01-950 7068).

IPUG setting up in Teddington. Interested? Contact: G. Squibb, 108, Teddington Park Road, Teddington, Middlesex.

MIDLANDS

Birmingham Computer Club. To be formed shortly, catering for all micro users. Fortnightly meetings planned but venue not yet fixex. Contact: Dr M Bayliss, 021-743 7197.

TRS-80 Independent User Group. Recently formed in Birmingham. Contact Mike Bayliss, 021-743 7197.

NORTHANTS

Anybody interested in forming a microcomputer users club in the Towcester (S. Northants) area, please contact R J Wellsted, 20 Hampton Court Close, Abbey Chase, Towcester, Tel: Towcester 51354 eves.

NOTTINGHAMSHIRE

Ashfield Computer Club. Meets 1st & 3rd Thurs each month at Carsic Junior School, membership £3 pa. Contact Deric Ellerby, tel 0380 75376 or Derrick Daines tel 0380 56198

OXFORDSHIRE

Oxfordshire Microcomputer Club. £5.00 p.a. Contact: S. C. Bird, 139 The Moors, Kidlington, Oxford OX5 2AF Tel: Kidlington (08675) 6703.

Microsoc the Oxford University micro group holds shared meetings with the Oxford Microcomputer Club. Contact: M. Bourla, St. John's College, Oxford.

SOUTH

IPUG South East Regional Group. Meets third Thursday each month, 7.30pm at Charles Darwin School, Jail Lane, Biggin Bill. Bi-monthly newsletter. Contact: W Cdr M Ryan, 164 Chesterfield Drive, Sevenoaks, Kent TN13 2EH, tel (0732) 53530.

SUFFOLK

Anyone interested in forming a Suffolk Computer Users' Club should contact Ian on Ipswich 831353 eves/weekends.

SURREY

Richmond Computer Club. Held the second Monday of each month at the Richmond Community Centre (20p per meeting), members have the use of a good range of equipment. Contact: Robert Forster, 18a The Barons, St. Margarets, Twickenham, Middx (01-892 1873).

Surrey Microprocessor Society. (SUMPS) Covering Surrey plus bits of South London and other adjacent counties. Anyone interested in joining, call Mike on 01-642 8362.

SUSSEX

A PET group is being formed on the Sussex/Surrey border, presently centered on Crawley & Horsham. Aims to meet monthly & produce a monthly newsletter. Contact: Richard Dyer, 33 Parham Rd, Ilfield, Crawley RH11 0ET.

A Crawley computer club has recently been formed, open to anyone interested in personal computing, with or without computing facilities. The intention is to hold meetings weekly, and publish a monthly or bi-monthly newsletter. Details, contact either Mr J. Fieldhouse, 18 Seaford Road, Broadfield, Crawley, West Sussex (Crawley 542509) — or — Mr J. M. Clarke, 31 Hyde Heath Court, Pound Hill, Crawley, West Sussex (Crawley 884207)

TYNE AND WEAR

Newcastle-upon-Tyne Personal Computer Society: meets first Tues each month in Room D103, Newcastle Polytechnic. Over 60 members sub £5.00. Several subgroups inc. PET, TRS-80 and S100 (last one meets weekly). Contact Pete 0632 573905 or John on 0632 579887.

WARWICKSHIRE

ACC (Midland) Group. They meet every 3rd Saturday in room P109 at Lanchester College, Coventry . . . no sub, no magazine. Contact: Roy Diamond (Chairman), 27 Loweswater Road, Coventry, Warks (0203 454061).

WEST MIDLANDS

Research Machines 380Z. West Midlands User Group. Further details from: Peter Smith, Birmingham Educational Computing Centre, Camp Hill Teachers Centre, Stratford Road, Birmingham, B11 1AR. Tel: 021 772 6534.

West Midlands Amateur Computer Club. Meets the 2nd & 4th Tuesday of each month, usually at Elmfield School, Love Lane, Stourbridge, West Midlands. Annual sub is £3 (£2 if full time student). . . visitors welcomed without obligation. For more information contact John Tracey of 100 Booth Close, Kingswinford, West Mids (0384 70097).

Compukit User Club. Details, contact S.H. Grisvenor Esq., 11 Bernard Road, Oldbury, Warley, West Midlands (021-422 3298).

WORCESTERSHIRE

Worcester & District Computer Club. Meets 2nd Monday monthly at 8 pm, Old Pheasant Inn, New Street, Worcester. Contact: D Stanton, 55 Vauxhall St, Rainbow Hill, Worcester WR3 8PA.

YORKSHIRE

Anyone interested in forming a micro group in the Doncaster area, contact Mr P Flinders, tel Doncaster 78954 or Doncaster 868 379, 6—9pm.

Shipley College Computer Group (Sorcerer/6800). They meet Tuesdays (software) and Wednesdays (hardware/advanced) between 7.00 & 9.00 pm. Contact Paul Channell on Shipley 595731.

West Yorkshire Microcomputer Group. Formed following an inaugural meeting on October 23rd, a varied diary of events has been drawn up. For details contact the Chairman, Phillip Clark, Care Computer Services, 15 Wellington Street, Leeds LS1 4DL (0532 450667) OR the Secretary, Keith Knaggs, Price Waterhouse & Co., Leeds (0532 448741).

South Yorkshire Personal Computing Group. Meetings are on the second Wednesday of each month in Room F135, St. Georges Building, Sheffield University. Experts and beginners welcomed alike, contact Paul Sanderson (Secretary), 8 Vernon Road, Totley, Sheffield S17 3QE (0742) 351895.

Pennine & District Computer Club. Open at both 26 and 51 Mill Hey, Haworth, W. Yorks. each Sat & Sun 10am to 10pm. Systems, books, magazines, members' shop. Contact: club at w/ends on Haworth 43007 or chairman, Douglas Bryant, on Bradford 569660.

York Computer Club. Meets every Monday at 8 pm at the Holgate YMC, New Lane, Acomb, York. Contact: S Wilson, tel: York 470464 after 6.

DIARY DATA

Manchester, England	(New Cent Hall) Micro Show. Contact: Online, 09274 28211	29 Apr — 1 May
Brussels, Belgium	Compec Europe. Contact: IPC Exhibitions Ltd, Surrey House, 1 Throwley Way, Sutton, Surrey SM1 4QQ. Tel: 01-643 8040	5 — 7 May
London	(Royal Hort Hall) Home Brew Show *(Beer, not micros! But we thought you'd still be interested — Ed)*	8 — 12 May
Nuremberg, Germany	European Consumer Electronics Show. Contact: Industrial & Trade Fairs Int Ltd, Radcliffe House, Blenheim Court, Solihull, West Midlands. Tel: 021-705 6707	10 — 13 May
Milan, Italy	International Electrical and Electronic Technology Exhibition — INTEL Contact: INTEL, Via Luciano Manara 1, 20122 Milan	23 — 27 May
Paris, France	Computer Software Exhibition —SOFT. Contact: Executive Conference Organisers Ltd, Acorn Studios, Barnes, London SW13 9HP. Tel: 01-748 0287	1 — 3 June
Utrecht, Holland	Europe Software Exhibition. Contact: ECC (Exhibition Agencies) Ltd, 11 Manchester Square, London W1M 5AB. Tel: 01-486 1951	2 — 4 June
Melbourne, Australia	Computers, Communications and Electronic Technology Exhibition conference — CETIA. Contact: CETIA '81, PO Box 259, Roseville, Sydney, NSW 2069	2 — 5 June
London	(Earl's Court) *Sunday Times* Business to Business Exbn. Contact: Silver Collins & Co, 01-407 4046	7 — 10 June
London	(Earl's Court) Electronics Comp Ind Fair COMPONENTS '81. Contact: Ind & Trade Fairs Ltd., 021-705 6707	9 — 12 June
Southampton, England	(Guildhall) Business Efficiency Exhibition. Contact: BETA, 8 Southampton Place, London WC1A 2EF. Tel: 01-405 6233	16 — 18 June
London, England	(West Centre Hotel) International Commodore PET Show. Contact: Baroness International on 01-734 2907	18 — 20 June

PCW SUBSET

Alan Tootill presents more useful assembler – language subroutines. If you'd like to contribute your routines (for any of the popular processors), send them to: Sub Set, PCW, *14 Rathbone Place, London W1P 1DE.*

This month we have an experiment in M6800 code and some Z80 arithmetic.

Motorola/ Z80bridge

For the experiment we are now giving in M6800 code three routines that have previously been published in Z80 code. This should help those more familiar with the Z80 to understand the M6800 code and vice versa. Let us know whether or not it does!

One point for Z80 practitioners to note is that the Motorola stack pointer points to the next location on the stack to be used and the TSX instruction puts the value of the stack pointer +1 (that is, the address of the last unremoved data actually stacked) into the IX index register.

The first two routines, FOWIM and GYCVM, are the Motorola equivalents of April's FOWIA and GRYCV. These get the current program address into a register and show how this can be used to access a table in a routine relative to the program location, thus making such routines position independent.

Datasheet

```
;= FOWIM – Get current program address.
;/ CLASS: 1
;/ TIME CRITICAL ? No.
;/ DESCRIPTION: Gives in IX the address of the instruction it
;/              is then at, after returning to the code that
;/              called it.
;/ ACTION:  IX←(SP) + 1
;/          IX←Address IX was pointing at
;/ SUBr DEPENDENCE: None
;/ INTERFACES:  None
;/ INPUT: None
;/ OUTPUT:  IX contains the address of the current program
;/          instruction; ie, the instruction immediately
;/          following the CALL to FOWIM
;/ REGs USED: IX
;/ STACK USE: None
;/ LENGTH: 4
;/ PROCESSOR: M6800
FOWIM:  TSX       ; point IX to main prog. return      30
                  ; address on stack.
        LDX 0,X   ; get return address into IX.        EE  00
        RTS       ; return.                            39
```

Datasheet

```
;=GYCVM – Gray code conversion
;/ CLASS: 1
;/ TIME CRITICAL?: No
```

```
;/ DESCRIPTION: Converts a four-bit binary number to Gray code.
;/ ACTION:  IX←address of current program instruction
;/          IX←IX + (A)
;/          A←contents of IX + displacement from returned
;/          address to start of table.
;/ SUBr DEPENDENCE: FOWIM
;/ INTERFACES:  None
;/ INPUT: The most significant nibble of the A register is zero
;/        and the least significant nibble holds the number to
;/        be converted.
;/ OUTPUT: The most significant nibble of the A register is zero
;/         and the least significant nibble holds the Gray code
;/         equivalent of the binary number input.
;/ REGs USED: IX, A
;/ STACK USE: 2
;/ LENGTH: 28
;/ PROCESSOR: M6800
GYCVM:  JSR  FOWIM  ; get addr. of current instr.   BD  XX  XX
        DEX         ; pre decrement                 09
        INC A       ; and increment registers.      4C
GYCV1:  INX         ; add original                  08
        DEC A       ; contents of A                 4A
        BNE GYCV1   ; to IX.                        26  FC
        LDA A 9,X   ; get chr allowing for table    A6  09
        RTS         ; offset (9) from prog. instr.  39
FCB 0,1,3,2,6,7,5,4     ; conversion    00 01 03 02
                        ;               06 07 05 04
FCB 12,13,15,14,10,11,9,8 ; table       0C 0D 0F 0E
                        ;               0A 0B 09 08
```

Now for something slightly more complex; ASBNM, the Motorola equivalent of November's ASCNO, ASCII to 16-bit binary conversion. ASBNM, closely following the method used in ASCNO, turns out to be twice as long, so should allow plenty of room for improvement from practised M6800 users. Can anybody offer a Motorola version in the 61 bytes it took the Z80 to do ASCNO?

To help Z80 users follow the M6800 code, Figure 1 (which vanished when we last did M6800 code in March) gives the state of the stack between the seventh instruction and the label EXASC, except when in routines NUMCH and ERR1.

ADDRESS OF	8, X L
CHR STRING	7, X H
MAIN PROG	6, X L
RETURN ADDRESS	5, X H
INTERMEDIATE	4, X B
RESULT	3, X A
NEGATIVE INDICATOR	2, X
CHARACTER STORE	1, X
1X→ LOOP COUNT	0, X
SP→	

Fig 1

Datasheet

```
;= ASBNM — ASCII to 16-bit binary conversion
;/ CLASS: 1
;/ TIME CRITICAL:  No
;/ DESCRIPTION:  Converts a string of ASCII characters, in the
;/               range +32767 to −32767, into a 2's complement
;/               binary number. The string may be preceded by
;/               a + or − sign and is terminated by any character
;/               outside the range 30H to 39H. If there is no
```

```
;/                  sign, a positive number is assumed.
;/ ACTION:   PUSH zeros into 5-byte workspace on stack
;/           (IX+1)← binary conversion of chr pointed
;/                   to by address at IX+7—8
;/           (IX+3—4)← 10*(IX+3—4) + (IX+1)
;/           (IX+7—8)← (IX+7—8)+1
;/              repeated until non-numeric chr encountered
;/           A,B← (IX+3—4)
;/ SUBr DEPENDENCE:  None
;/ INTERFACES:  None
;/ INPUT: The address of the ASCII character string is
;/        placed on the stack before the routine is called.
;/ OUTPUT:  If the ASCII string is valid, the 2's complement
;/          equivalent is in accumulators A and B, the carry
;/          is clear, IX points to the terminating character
;/          and the address of the terminating chr is on the stack;
;/          if the first chr of the ASCII string (after any sign)
;/          is non-numeric, A,B = 1, the carry is set and the
;/          address of the string remains on the stack and in IX;
;/          if overflow occurs, there is a jump to an error
;/          routine (not provided).
;/ REGs USED:  A,B,IX
;/ STACK USE:  7
;/ LENGTH:  117
;/ PROCESSOR: M6800

ASBNM:  CLR  A          ; zeroise                    4F
        PSH  A          ; working                    36
        PSH  A          ; storage                    36
        PSH  A          ; on                         36
        PSH  A          ; stack                      36
        PSH  A          ; and                        36
        TSX             ; point IX to it.            30
        LDX    7,X      ; get chr string addr in IX. EE 07
        LDA  A 0,X      ; get first character.       A6 00
        TSX             ; point IX to stack.         30
        CMP  A #$2B     ; jump if                    81 2B
        BEQ    AN1      ; first chr + .              27 08
        CMP  A #$2D     ; jump if first              81 2D
        BNE    AN2      ; chr not —.                 26 0A
        LDA  B #7       ; set negative               C6 07
        STA  B 2,X      ; indicator.                 E7 02
AN1:    INC    8,X      ; increment                  6C 08
        BNE    AN2      ; chr string                 26 02
        INC    7,X      ; address.                   6C 07
AN2:    INC    4,X      ; set result to 1.           6C 04
        LDX    7,X      ; get chr string addr in IX. EE 07
        BSR    NUMCH    ; convert 1st ch to binary.  8D 43
        TSX             ; point IX to stack.         30
        BCS    EXASA    ; jump if 1st chr invalid.   25 30
        DEC    4,X      ; reset result to zero.      6A 04
AN3:    LDX    7,X      ; get chr string addr in IX. EE 07
        BSR    NUMCH    ; current chr to binary.     8D 3A
        TSX             ; point IX to stack.         30
        BCS    EXASC    ; jump if end of string.     25 26
        INC    8,X      ; increment                  6C 08
        BNE    AN4      ; chr string                 26 02
        INC    7,X      ; address.                   6C 07
AN4:    STA  A 1,X      ; store current binary chr.  A7 01
        LDA  B #9       ; set loop count             C6 09
        STA  B 0,X      ; on stack to 9.             E7 00
        LDA  A 3,X      ; load intermediate          A6 03
        LDA  B 4,X      ; result into A,B            E6 04
AN5:    ADD  B 4,X      ; and multiply               EB 04
        ADC  A 3,X      ; it by 10,                  A9 03
        BMI    ERR1     ; jumping to                 2B 2F
        DEC    0,X      ; error routine              6A 00
        BNE    AN5      ; if overflow.               26 F6
        ADD  B 1,X      ; add in current chr         EB 01
        ADC  A #0       ; binary value,              A9 00
        BMI    ERR1     ; jumping if overflow.       2B 25
        STA  B 4,X      ; store intermediate         E7 04
        STA  A 3,X      ; result.                    A7 03
        BRA    AN3      ; loop for next chr.         20 D9
EXASC:  CLC             ; at normal end clear carry. 0C
EXASA:  INS             ; restore                    31
        INS             ; stack                      31
```

```
                INS                     ; pointer and                   31
                PUL  A                  ; get result,                   32
                PUL  B                  ; now final, into A,B.          33
                DEC     2,X             ; test negative indicator       6A   02
                BMI     EXASB           ; & jump if string positive     2B   06
                COM B                   ; else                          53
                COM A                   ; negate                        43
                ADC B  #0               ; the                           C9   00
                ADC A  #0               ; result.                       89   00
EXASB:          RTS                     ; return.                       39
; NUMCH — chr in (IX) to binary number in A; cy set if none.
NUMCH:          LDA  A  0,X             ; get current chr.              A6   00
                SUB  A  #$30            ; jump with carry set           80   30
                BCS     EXNUM           ; if zero.                      25   07
                CMP  A  #$0A            ; jump if 9.                    81   0A
                BCC     PRXNM           ; 9.                            24   02
                CLC                     ; clear carry                   0C
                RTS                     ; and return.                   39
PRXNM:          SEC                     ; set carry                     0D
EXNUM:          RTS                     ; and return                    39
; ERR1 — your own error routine in place of this brief indication.
SCREEN          EQU     nnnn            ; suitable location in video RAM
ERR1:           LDA  A  #$45            ; load 'E'                      86   45
                STA  A  #SCREEN         ; display it on screen          B7   nn   nn
                RTS                     ; and return from ASBNM         39
```

Arithmetic

There are two small amendments to March's four-byte integer divide. Paul Jenner gave these changes to his DIV4 but we were unable to get them into the printed version. The instruction JR Z, WENT is redundant and should be omitted and, immediately before the last RET, OR A should be inserted so that the carry is always clear after a valid calculation. These changes make the length of the routine 53 bytes, the 39th machine code byte 07 instead of 09, the 51st byte DB instead of D9 and cause the 40th and 41st bytes to be deleted and byte B7 to be inserted before the last byte.

The routines to divide and convert ASCII to binary and binary to ASCII will be given next month.

PROGRAMS

TRS-80 Demon Hunts

by Easy Computing

Catch the demons and replace them with a gravestone — great fun.

```
70 '                  ** VARIABLE INITIALIZATION **
80 CLS:CLEAR175:DEFINTA-Z:H=9999
90 A$=STRING$(57,153):B$=STRING$(63,153):E$=STRING$(3,153)
100 C$=STRING$(3,32):V$=CHR$(182)+CHR$(140)+CHR$(185)
110 Y$=CHR$(191)+CHR$(179)+CHR$(191):U$="####":US$="##":P=15360
120 D$=CHR$(140)+CHR$(191)+CHR$(140):GOSUB340
130 PRINT@3,A$;:PRINT@960,B$;:FORE=64TO896STEP64:PRINT@E,E$;
140 PRINT@E+60,E$;:NEXT
150 V=481:U=V:Y=451:X=Y:R=RND(3)+1
160 '                      ** ACTUAL GAME **
170 FORS=0TO30000:PRINT@Y,C$;:D=PEEK(14400)
180 IFD=64Y=Y+3ELSEIFD=32Y=Y-3ELSEIFD=16Y=Y+64ELSEIFD=8Y=Y-64
190 N=PEEK(P+Y):IFN=32X=YELSEIFN(182Y=XELSE260
200 PRINT@Y,Y$;:IFPEEK(P+V)=182PRINT@V,C$;
210 PRINT@60,USINGU$;TS+S;:M=M+1:IFM=3R=RND(4):M=0
220 IFR=1V=V-3ELSEIFR=2V=V-64ELSEIFR=3V=V+3ELSEIFR=4V=V+64
230 B=PEEK(P+V):IFB=32U=VELSEIFB=153V=U:M=0:R=R+1:IFR)4R=1
240 IFB()191IFB=140NEXTSELSEPRINT@V,V$;:NEXTS
250 '                    ** SCORE ROUTINE **
260 TS=TS+S:PRINT@Y,D$;:K=K+1:PRINT@0,USINGUS$;K;
270 FORT=0TO1000:NEXT:IFK(20THEN150
280 CLS:IFTS)HTHENPRINTTAB(28)HN$;" :";H:GOTO310
290 H=TS:PRINTTAB(13)"WELL DONE YOU ONLY NEEDED";H;"TIME-UNITS"
300 PRINT:PRINTTAB(18)"PLEASE ENTER YOUR NAME";:INPUTHN$
310 PRINT:PRINTTAB(19)"DO YOU WANT TO PLAY AGAIN";:INPUTP$
```

PROGRAMS

```
320 IFLEFT$(P$,1)="N"THENENDELSETS=0:K=0:CLS:GOTO130
330 '                    ** INSTRUCTIONS **
340 PRINTTAB(17)"DEMON HUNT BY EASY COMPUTING"
350 PRINTTAB(17)STRING$(28,34)
360 PRINTTAB(22)"-= INSTRUCTIONS =-":PRINT
370 PRINT"THE OBJECT OF THE GAME IS TO KILL A MOVING DEMON ";
380 PRINTV$;" USING THE  ARROW KEYS. A DEAD DEMON WILL BE ";
390 PRINT"DISPLAYED IN THE FORM OF A     CROSS ";D$;". ";
400 PRINT"THE CROSS WILL BE AN OBSTACLE FOR YOU ";Y$;
410 PRINT" BUT NOT FORTHE NEXT DEMONS. AS SOON AS YOU KILLED ";'
420 PRINT"20 DEMONS THE GAME IS    OVER."
430 PRINT:PRINTTAB(19):INPUT"PRESS ENTER TO CONTINUE";C:CLS
440 RETURN
```

PET Zap

by A King

Here's an interesting variation on the alien invaders game. The invaders can approach from three directions.

```
10 FORI=2TO11:POKE836+I,0:NEXT:POKE59468,14:PRINT"■■■■■■■■■■■■■■CAP!. BY A.KING"
20 PRINT"■■IN  THIS  GAME  YOU  MUST  STOP  AN"
30 PRINT"■■ALIEN  INVASION  BY  SHOOTING  THEM"
40 PRINT"■■WITH  YOUR  LASER. YOUR  BASE  CAN "
50 PRINT"■■BE  MOVED  RIGHT  USING '*' AND  LEFT"
60 PRINT"■■USING 'Z'.TO  FIRE  YOUR  LASER  PRESS";
70 PRINT"■■'0'. THE  ALIENS  MOVE  IN  THREE"
80 PRINT"■■DIRECTIONS: STRAIGHT  DOWN  AND "
90 PRINT"■■DIAGONALLY  LEFT & RIGHT. THE  GAME "
100 PRINT"■■ENDS  WHEN  ONE  ALIEN  LANDS  AND "
110 PRINT"■■YOUR SCORE IS SHOWN.  GOOD LUCK"
120 PRINT"■■INPUT DIFFICULTY.(1-9,1=HARD,9=EASY)":POKE158,0
130 GETA$:IFVAL(A$)<1ORVAL(A$)>9THEN130
140 POKE59468,12:PRINT"■":FORI=33728TO33768:POKEI,160:NEXT:H=VAL(A$)+1:Y=33688
150 Y1=112:Y2=113:Y3=110:T=32769:R1=33725:L1=Y:R=24:O=32:F=10:J=32:P=151
160 A1=INT(RND(TI)*38+T):A2=INT(RND(TI)*38+T):B1=INT(RND(TI)*3+39)
170 B2=INT(RND(TI)*3+39):POKEY,Y1:POKEY+1,Y2:POKEY+2,Y3
180 L=PEEK(P):IFL<>FANDL<>RANDL<>OTHEN220
190 IFL=FTHEN300
200 IFL=RANDY<R1THENPOKEY,C:Y=Y+1:POKEY,Y1:POKEY+1,Y2:POKEY+2,Y3:GOTO220
210 IFL=ORANDY>L1THENPOKEY+2,C:Y=Y-1:POKEY,Y1:POKEY+1,Y2:POKEY+2,Y3
220 G=G+1:IFG>HTHENG=1
230 ONGGOTO240,250,180,180,180,180,180,180,180,180,180
240 A=A1:B=B1:GOSUB260:A1=A:GOTO180
250 A=A2:B=B2:GOSUB260:A2=A:GOTO180
260 A=A+B:IFPEEK(A)=ORPEEK(A)=88THENPOKEA-B,C:POKEA,88:RETURN
270 PRINT"■■■■■■■■■■THE ALIENS HAVE LANDED.":H1=PEEK(836+H)
280 PRINT"■■YOU ZAPPED",S;"INVADERS ON SKILL LEVEL";H-1:IFS>H1THENH1=S
290 PRINT"■■■■■■■■■■■■HIGH SCORE =";H1:POKE836+H,H1:RUN120
300 M=Y-39:FORI=MTOJSTEP-40:IFPEEK(I)=CTHENPOKEI,32:NEXT:GOTO330
310 S=S+1:POKEI,42:IFI=A1THENA1=INT(RND(TI)*38+T):B1=INT(RND(TI)*3+39):GOTO330
320 A2=INT(RND(TI)*38+T):B2=INT(RND(TI)*3+39)
330 J=I:FORI=MTOJSTEP-40:POKEI,C:NEXT:G=G+1:IFG>2THENG=1
340 GOTO230
350 REM *** IF THE USER BECOMES BORED ON LEVEL 1. THEN HE MIGHT LIKE TO ***
360 REM *** REPLACE LINE 340 WITH THE FOLLOWING - ***
370 REM *** 340 B1=INT(RND(TI)*3+39):B2=INT(RND(TI)*3+39):GOTO230 ***
```

UK101 Get them

by John Rawcliffe

Turn the laser gun to fire at fast moving aliens.

```
1 REM  GET THEM BY JOHN RAWCLIFFE
2 CLEAR:GOSUB500
4 POKE530,1:L=16:X=53731:K=57088
5 S=53792:FORN=1TO16:READP:POKES+P,213:NEXT
6 DATA0,10,18,70,121,148,174,198,388,404,429
7 DATA-272,-302,-320,-332,-433
```

PROGRAMS

```
 8 RESTORE
 10 POKEX,L:M1=0:O=0:F=0
 15 IFO-H)1THENFORI=1TO(O-H):NEXT
 16 IFM1=1THEN200
 18 C=PEEK(K):POKEK,247:POKEK,127:M=X
 20 IFC=247THENM1=1:GOTO200
 22 IFC=191THEN40
 24 IFC=127THEN44
 25 FORI=1TO10:NEXT
 26 IFO=1THEN110
 28 R=INT(RND(8)*8):O=1:GOTO100
 40 L=L+1:IFL=24THENL=16
 42 POKEX,L:GOTO24
 44 L=L-1:IFL=15THENL=23
 46 POKEX,L:GOTO26
 48 M1=0:GOTO18
 50 FORI=1TO200:NEXT:RETURN
 80 FORI=1TO16:PRINT:NEXT:RETURN
 100 IFR=1THENA=54237:GOTO120
 101 IFR=2THENA=53289:GOTO130
 102 IFR=3THENA=54138:GOTO140
 103 IFR=4THENA=54028:GOTO150
 104 IFR=5THENA=53306:GOTO160
 105 IFR=6THENA=54243:GOTO174
 106 IFR=7THENA=53283:GOTO184
 107 A=53276:GOTO194
 110 IFR=1THEN120
 111 IFR=2THEN130
 112 IFR=3THEN140
 113 IFR=4THEN150
 114 IFR=5THEN160
 115 IFR=6THEN170
 116 IFR=7THEN180
 117 GOTO190
 120 POKEA,32:A=A-64:IFA(53324THEN198
 124 POKEA,2:GOTO15
 130 POKEA,32:A=A+64:IFA)54202THEN198
 134 POKEA,2:GOTO15
 140 POKEA,32:A=A-1:IFA(54092THEN198
 144 POKEA,2:GOTO15
 150 POKEA,32:A=A+1:IFA)54074THEN198
 154 POKEA,2:GOTO15
 160 POKEA,32:A=A-1:IFA(53260THEN198
 164 POKEA,2:GOTO15
 170 A=A-64:POKEA+64,32:IFA=XTHEN400
 174 POKEA,2:GOTO15
 180 A=A+64:POKEA-64,32:IFA=XTHEN400
 184 POKEA,2:GOTO15
 190 A=A+65:POKEA-65,32:IFA=XTHEN400
 194 POKEA,2:GOTO15
 198 O=0:GOTO15
 200 IFL=16THEN220
 202 IFL=17THEN230
 204 IFL=18THEN240
 206 IFL=19THEN250
 208 IFL=20THEN260
 210 IFL=21THEN270
 212 IFL=22THEN280
 214 GOTO290
 220 V=-64:GOSUB300:IFF=1THEN10
 221 IFM=XTHEN223
 222 POKEM,32
 223 M=M-64:IFM(53260THEN48
 225 POKEM,140:GOSUB300:IFF=1THEN10
 228 GOTO26
 230 V=-63:GOSUB300:IFF=1THEN10
 231 IFM=XTHEN233
 232 POKEM,32
 233 M=M-63:IFM(53260THEN48
```

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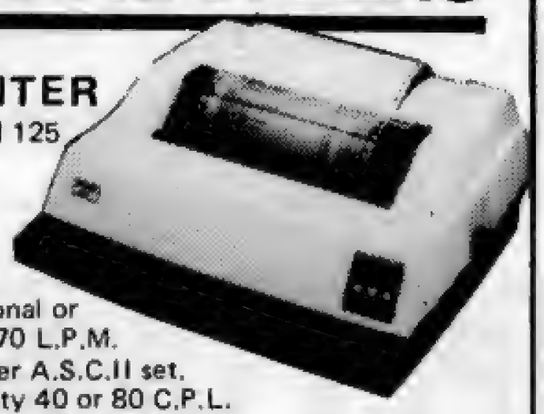

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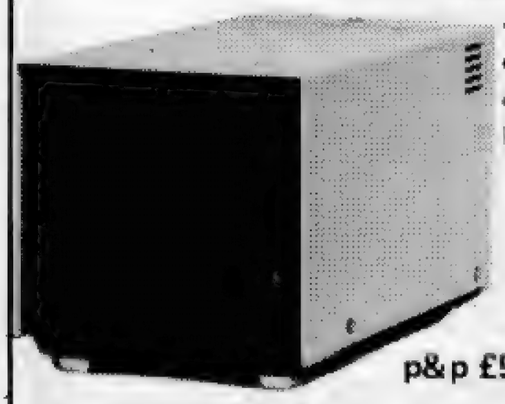

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PROGRAMS

```
235 POKEM,189:GOSUB300:IFF=1THEN10
239 GOTO26
240 V=2:GOSUB300:IFF=1THEN10
241 IFM=XTHEN243
242 POKEM,32
243 M=M+2:IFM>53756THEN48
245 POKEM,131:GOSUB300:IFF=1THEN10
249 GOTO26
250 V=65:GOSUB300:IFF=1THEN10
251 IFM=XTHEN253
252 POKEM,32
253 M=M+65:IFM>54266THEN48
255 POKEM,190:GOSUB300:IFF=1THEN10
259 GOTO26
260 V=64:GOSUB300:IFF=1THEN10
261 IFM=XTHEN263
262 POKEM,32
263 M=M+64:IFM>54266THEN48
265 POKEM,140:GOSUB300:IFF=1THEN10
269 GOTO26
270 V=63:GOSUB300:IFF=1THEN10
271 IFM=XTHEN273
272 POKEM,32
273 M=M+63:IFM>54266THEN48
275 POKEM,189:GOSUB300:IFF=1THEN10
279 GOTO26
280 V=-2:GOSUB300:IFF=1THEN10
281 IFM=XTHEN283
282 POKEM,32
283 M=M-2:IFM<53708THEN48
285 POKEM,131:GOSUB300:IFF=1THEN10
289 GOTO26
290 V=-65:GOSUB300:IFF=1THEN10
291 IFM=XTHEN293
292 POKEM,32
293 M=M-65:IFM<53260THEN48
295 POKEM,190:GOSUB300:IFF=1THEN10
299 GOTO26
300 IFPEEK(M+V)=2THEN304
302 RETURN
304 POKEM,32:POKEX,L:POKEA,42:GOSUB50:POKEA,32
306 H=H+1:F=1:GOTO302
400 POKEM,32:POKEX,42:GOSUB50:POKEX,226
402 GOSUB50:POKEX,32:POKEX+1,225:POKEX-1,224
404 GOSUB50:POKEX+1,32:POKEX-1,32:GOSUB50
406 POKEX,L:M=0:D=0:B=B+1:IFB=5THEN410
408 F=0:GOTO15
410 GOSUB80
412 PRINT" YOU HIT ";H;" ALIENS"
414 INPUT" AGAIN";A$
416 IFLEFT$(A$,1)="Y"THEN2
420 POKE530,0:END
500 GOSUB80
502 INPUT" DO YOU WANT INSTRUCTIONS";A$
504 IFLEFT$(A$,1)="Y"THEN508
506 GOTO522
508 PRINT:PRINT:PRINT
510 PRINT" DESTOY THEM BEFORE THEY GET YOU"
511 PRINT:PRINT
512 PRINT" USE KEY 1 TO TURN ANTI-CLOCKWISE"
514 PRINT" USE KEY 2 TO TURN CLOCKWISE"
516 PRINT" USE KEY 5 TO FIRE RAYS":PRINT:PRINT
518 PRINT"WHEN YOU ARE HIT 5 TIMES YOUR SCORE APPEARS"
520 PRINT:PRINT:PRINT:PRINT
522 INPUT" SKILL 1(HARD)-40(EASIER)";D
523 IFD<1THEND=1
524 IFD>40THEND=40
530 GOSUB80:RETURN
```

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PROGRAMS

Acorn Atom Missile Dodge by Stuart Johnson

This program gives you three ships which you have to move from side to side to dodge missiles. SHIFT moves them left, REPT moves them right. The number of missiles is set by the 'Difficulty' question at the start. Note that the labels' lower case letters are actually the corresponding shifted characters.

```
 5 @=0;S=0;P.$12;IN."DIFFICULTY = "U
10 F.G=1 TO 3;A=16;?#E1=0
20 F.L=1 TO 15;P.';N.
50 E=A.R.%10;IF E<U; GO.70
60 E=A.R.%32;E?#81E0=32+G
70 P.';S=S+(9-U)*G
80 IF ?#B001<>#FF;GO.a
81 IF ?#B002=151 OR ?#B002=135;GO.b
90 GOS.w;GO.50
100aA=A-1;IF A<0 A=0
105 GOS.w;GO.81
110bA=A+1;IF A>30 A=30
120 GOS.w;GO.50
200wA ?#8000=48+4-G;WAIT
205 IF A ?#8020<>32 GO.300
210 R.
300 P.'$30 "LOST BASE #"4-G'"SCORE: "S'
301 U=U-2*G;IF U>1 U=1
302 P.3-G" BASES LEFT"'
303 IF G<3 P."DIFFICULTY NOW = "U'
304 F.T=1 TO 120;WAIT;N.
305 N.;P."GAME OVER"';E.
```

'Patterns' program

```
100 INIT
110 DIM C(16,4)
120 DIM D(16)
130 DIM S(16)
140 DIM T(16,4)
150 DIM U(4)
160 DIM V(4)
```

Arrays as shown in Tables 1 and 2

```
170 DATA -2,-1,-1,-2,-1,1,0,-2
180 DATA 0,0,0,-2,0,0,-2,-2
190 DATA -2,0,1,-1,1,1,1,1
200 DATA 1,0,0,0,0,0,-2,0
210 DATA -2,0,0,0,0,0,0,1
220 DATA 0,0,0,0,0,0,-2,0
230 DATA -2,-2,0,0,0,-2,0,0
240 DATA 0,-2,0,0,0,-2,-2,0
250 DATA 15,0,0,0,0,15,0,0,0,0,0,0,0,0,0,0
260 DATA 0,0,0,0,0,0,0,0,0,0,0,0,0,0,1,1
270 DATA -1,-1,-1,1,-1,-1,1,-1
280 DATA -1,1,-1,-1,1,-1,-1,-1
290 DATA -1,-1,1,1,-1,1,1,-1
300 DATA 1,1,-1,-1,1,-1,-1,1
310 DATA -1,1,-1,1,1,-1,1,-1
320 DATA -1,1,1,1,1,1,1,-1
330 DATA 1,1,-1,1,1,-1,1,1
340 DATA 1,1,1,1,-1,-1,-1,-1
350 DATA -1,4,1,-4,3,4,1,2
360 READ C,D,S,T,U,V
370 F=1
380 F=F+1
390 IF F=6 THEN 380
400 Q=0
```

Values as shown in Tables 1 and 2

```
410 IF F<17 THEN 580
420 PRINT D
430 F=F-1
440 IF F=5 THEN 430
450 IF F>1 THEN 470
460 STOP
470 Q=D(F)
480 D(F)=0
490 S(Q)=0
500 FOR I=1 TO 4
510 IF C(F,I)=-2 THEN 570
520 G=F+U(I)
530 IF D(G)>0 THEN 570
540 C(F,I)=0
550 J=V(I)
560 C(G,J)=0
570 NEXT I
580 Q=Q+1
590 IF Q>14 THEN 430
600 IF S(Q)>0 THEN 580
610 FOR I=1 TO 4
620 IF C(F,I)=0 THEN 640
630 IF C(F,I)*T(Q,I)<0 THEN 580
640 NEXT I
650 D(F)=Q
660 S(Q)=1
670 FOR I=1 TO 4
680 IF C(F,I)<>0 THEN 730
690 G=F+U(I)
700 J=V(I)
710 C(G,J)=T(Q,I)
720 C(F,I)=T(Q,I)
730 NEXT I
740 GO TO 380
```

PATTERNS

Continued from page 78

a solution of this kind is to look for configurations in which every cell has an even number of paths to and from it. Figure 13 shows the simplest arrangement I have found.

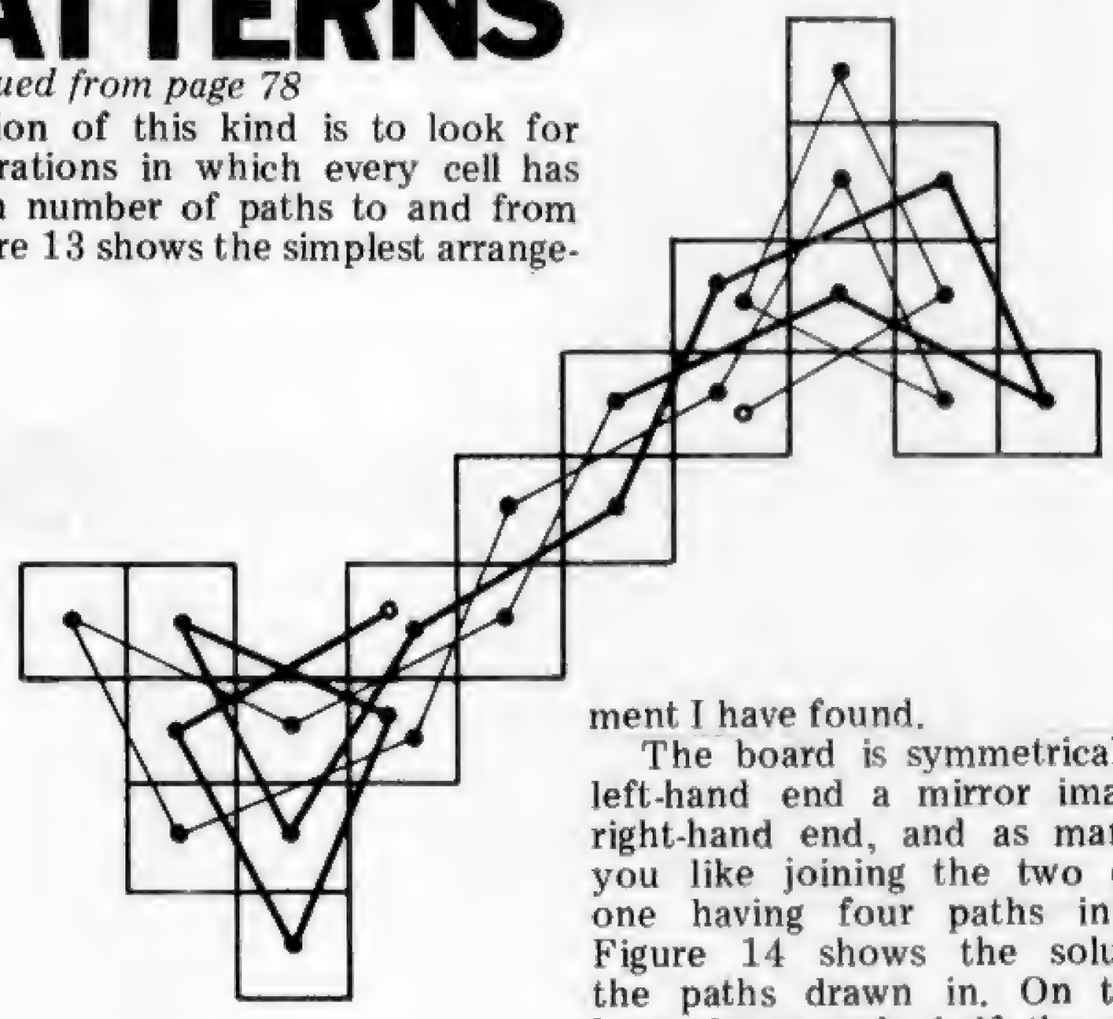


Fig 16 A stairway of pairs of cells.

The board is symmetrical, with the left-hand end a mirror image of the right-hand end, and as many cells as you like joining the two ends, each one having four paths in and out. Figure 14 shows the solution with the paths drawn in. On the right I have shown only half the path, while on the left the complete path for that part of the board is shown. One half

is shown in a dotted line and the other half in a solid line, but they are joined together to form one continuous path round that end of the board. This path round the whole board is re-entrant, to use the usual jargon of the literature

-2 (16) -1 / -1	-1 (0) 0 / 1	0 (0) 0 / 0	0 (0) -2 / 0
-2 (0) 1 / 0	1 (15) 1 / 1	1 0 0 / 0	0 0 -2 / 0
-2 (0) 0 / 0	0 (0) 0 / 0	0 (0) 0 / 0	0 (0) -2 / 0
-2 (0) 0 / -2	0 (0) 0 / -2	0 (0) 0 / -2	0 (0) -2 / -2

Table 3 Initial values for cell data in arrays C and D as in Table 1

on Knight's moves: that is, it is continuous, and the tour can start on any cell and will end on the same cell.

It is also possible to have just two cells on a board which have an odd number of paths in and out. One of these will then be the starting point and the other will be the end of the path.

Thus, there may be symmetrical solutions with one odd-valued cell at each end. In searching for the simplest solution I have looked at arrangements with two rows of cells, either both together, as in Figures 15(a), or one row apart, as in Figure 15(b). In this second case, remember that there can only be one block of cells used in the middle row to join the other two rows together — otherwise an inland sea of unused cells would be formed.

I have not found any such configuration with few enough odd-valued cells: 0 or 2. But I have not convinced myself, let alone proved, that there is no solution the main part of which is two rows of cells with a few extra cells at each end or in the middle to eliminate the odd-valued cells.

If you find any such boards, or any other interesting results relating to these complete Knight's tours then please write and let me know c/o *PCW*, 14 Rathbone Place, London W1P 1DE.

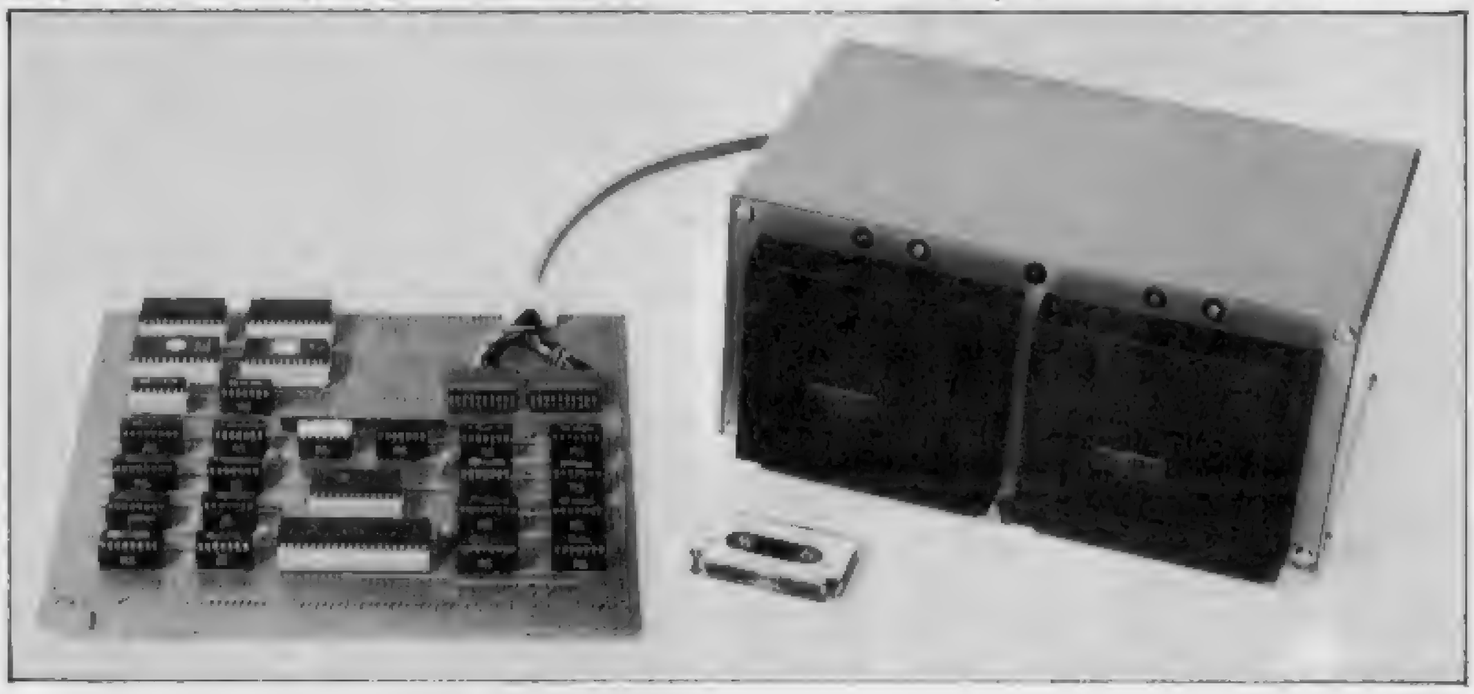
Since completing this article, I have found one configuration based on a stairway of pairs of cells, which can be thought of as two staggered rows. Some extra cells are needed at each end to allow the route to turn round. This is shown in Figure 16. Further pairs of cells can be added to the middle of the stairway without limit to make a board as large as you like.

MAKING TRACKS

Continued from page 83

write command is aborted. From experience of the overall reliability of the system this is likely to indicate a physically damaged tape and there is therefore little advantage in using more than two write/read cycles. Each block is prefaced by the memory location from which it originated and the number of valid bytes in the block.

The file delete command alters the directory but does not actually erase the relevant data block(s). The 'deleted' blocks are then available and may be overwritten by the next write command. This tends to keep the valid data blocks concentrated towards the



beginning of the tape and hence to minimise access times.

The catalog shows the tape number, the DCR (A or B), the number of free blocks and lists the filenames and file-types of all files on that track. It also indicates if the track is write protected. TOS detects data errors, syntax errors and tape drive errors (eg, no cassette present) and prints relevant screen messages.

A new tape must be initialised before use under TOS. The initialisation routine prompts for a tape identification number and then writes an 'empty' directory onto the tape. The data blocks do not require to be formatted in any way at this stage. TOS contains check routines which prevent a previously used tape from being reinitialised by accident.

The command table does not contain a direct command to erase tapes. This was purposely omitted to avoid accidental erasure, but the tape can be erased by direct monitor commands to the I/O ports used by the interface.

Fig 6

Many applications require files to be written, read or deleted during the execution of machine code of Basic programs. These can be achieved by calling the relevant subroutines within TOS and providing the necessary arguments.

Finally

The prototypes have now been running for several months. Although the transfer rate and the access times are obviously slower than those of disk systems, this has not proved to be a serious practical disadvantage. The reliability is high; after some 48 hours of repeatedly reading and writing 32k files without any error it was decided that the probability of a 'nasty' mains spike was higher than that of a tape system failure and the test was discontinued. The system has met our initial specifications and has shown that, for many users of smaller microcomputers, reasonably sophisticated tape-based storage can provide an acceptable alternative to the more expensive disk systems.

COMPUTER GAMES

BRIDGE

Continued from page 70

of advice — try to use a 'natural' bidding system (one in which the bids tend to reflect the obvious features of the hand) rather than an 'artificial' system (in which most of the bids form an apparently obscure code).

Most books on bidding will offer advice on how many high card points are needed to make contracts at various levels. In 'Bridge for Beginners' (by Victor Mollo and Nico Gardener), for example, we find that a useful guideline is:

22-25 points are needed in the combined hands to make any contract
26 points are needed to make 3 No-Trumps, 4 Hearts or 4 Spades, or 5 Clubs or 5 Diamonds
34 points are needed to make a slam (12 or 13 tricks)

These guidelines are extremely useful, inasmuch as they can set an upper limit on the program's bidding. In our earlier example, once the program knows that it and its partner (playing North-South) hold less than 34 points, which is when the second bid is made (South's one Spade), it is immediately obvious that a slam is not a real possibility, so the maximum contract is a game contract and the highest possible bid is 5 Diamonds).

The manner in which the algorithm operates is simplicity itself. The program first asks the question 'can I bid again without exceeding the safe limit?', where the safe limit is defined by the above guidelines. If the answer to this question is 'yes', the program simply examines every one of its legal bids, determines what would be meant by

each of these bids, and then performs some sort of matching exercise to produce a numerical score that represents the accuracy with which each bid describes the hand (bearing in mind what has already been bid). In a situation where the program is responding to an asking bid (eg, Blackwood or Stayman) there is no problem — the program simply gives the correct answer to the asking bid. But in the general case the program must evaluate each bid and then choose the bid with the highest score, or, if two or more bids have a similarly high score, the program selects the lower bid so that it can convey information in an economic manner.

How exactly this matching procedure is programmed will depend entirely on the type of bidding system you employ in your program, but a few hints may be useful for setting you on the right track. Firstly, we should consider a situation in which the program ought to make an asking bid. This might happen when it has discovered that it and its partner have 34 points or more between the two hands. The program may wish to know how many aces and kings are in its partner's hand (unless it has all the aces and kings itself), in which case it bids 4 No-Trumps. If the answer indicates that its partner has all the missing aces, the program can then ask how many kings are in its partner's hand. It will then find out whether the partnership is missing any of the important top cards and make its decision as to whether it can afford to bid 7 (for a Grand Slam) or only 6 (a Small Slam). Asking bids and their responses are as easy for a computer program as for a human player.

In a more general situation, the program must decide the extent to which a bid conveys information that has not already been conveyed. One way to do this is to count the number of variables which can be updated after making a particular bid. If a bid provides information which gives useful information about three of the variables, then the bid is, in some sense, more useful to the program's partner than a bid which gives useful information about only two variables.

One final point, which is important to implement because of the necessity of playing a contract in the best suit (or in No-Trumps if that is better than a suit contract): throughout the bidding the program should keep some kind of measure for each suit and for No-Trumps. This measure should indicate the desirability of playing a contract in that suit. At the start of the hand, when the cards are dealt, the measures might simply be the number of high card points in each of the suits (excluding the points for singletons and voids). For No-Trumps the measure should be zero. When the program's partner makes a bid, the number of high card points for the suit bid should be increased by (say) 8 for the first time that partner bids the suit, 4 for the second time and 2 for the third time. If the program's partner bids all of the suits in which the program does not have adequate control (either an ace, or a king and one other card, a queen and two other cards or a jack and three other cards), then the number of points assigned to No-Trumps can be adjusted to some high value (say 15). Each time that the partner bids another suit, which he has not yet bid, this score is increased by 2. The program then has a relatively easy measure of whether each suit is worthwhile, and whether No-Trumps is a possibility. Then, as the level of the bidding gets nearer and nearer to the guideline limits, the program can easily make a decision about the final contract. It is then only important to avoid making a bid which is so high that partner can no longer make a safe bid (ie, a bid within the guideline limits) in a suit which is deemed to be acceptable.

Next month, I shall write about playing the hand once the bidding is over. In the meantime, I suggest that you find a good book on bidding and select an easily programmable system.

BLUDNERS

The gremlins struck at February's programs section with a vengeance — pages 138 and 139 were somehow transposed with pages 140 and 141.

March's 'TRS-80 Rocket Attack' contains a couple of hard-to-read lines. Line 3170 should be GOTO 9000 and 9020 ends with POKE EE, E. Also the 'TRS-80 Giant Trap' (page 145) is actually (blush) for the PET!

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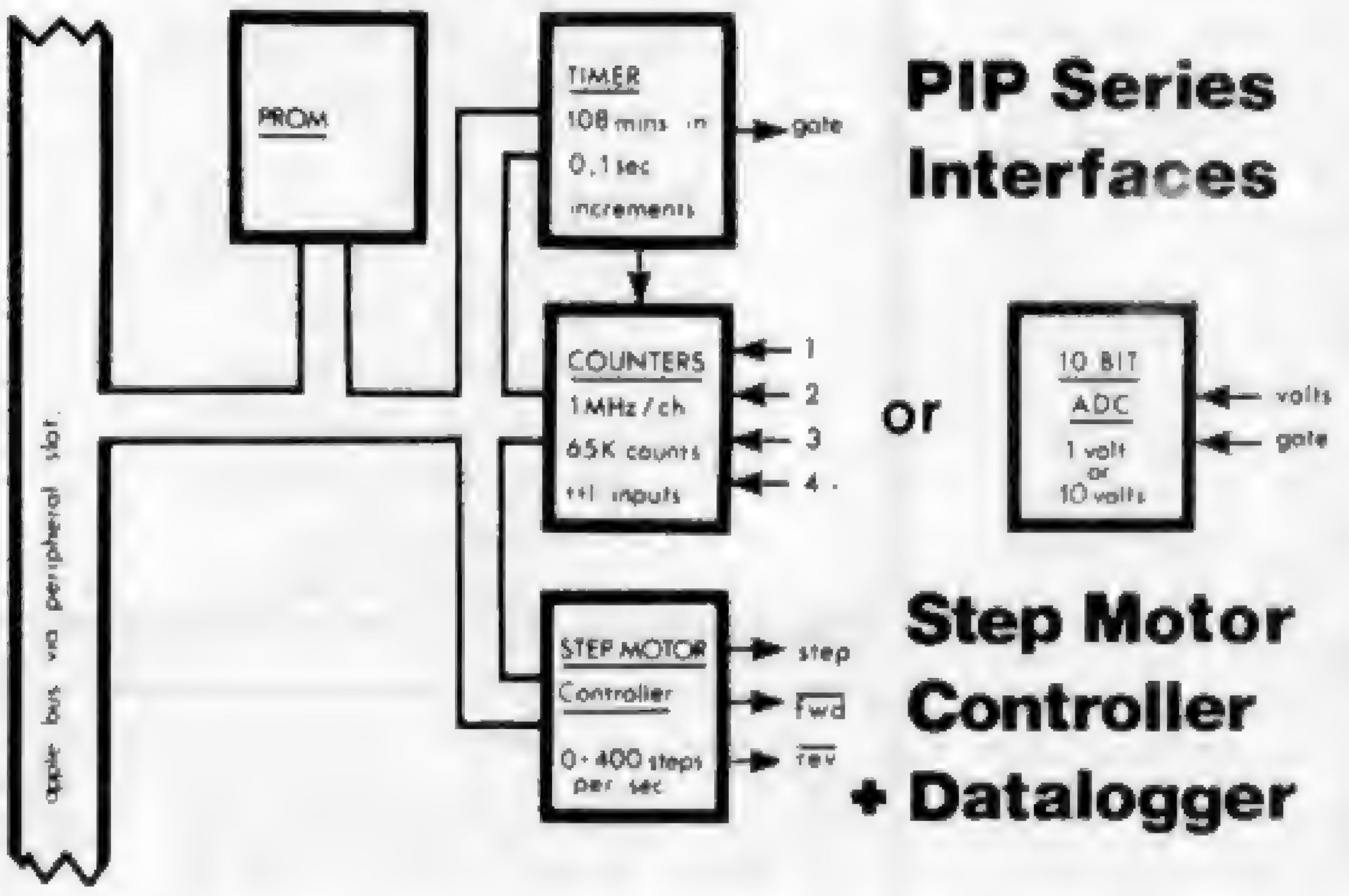

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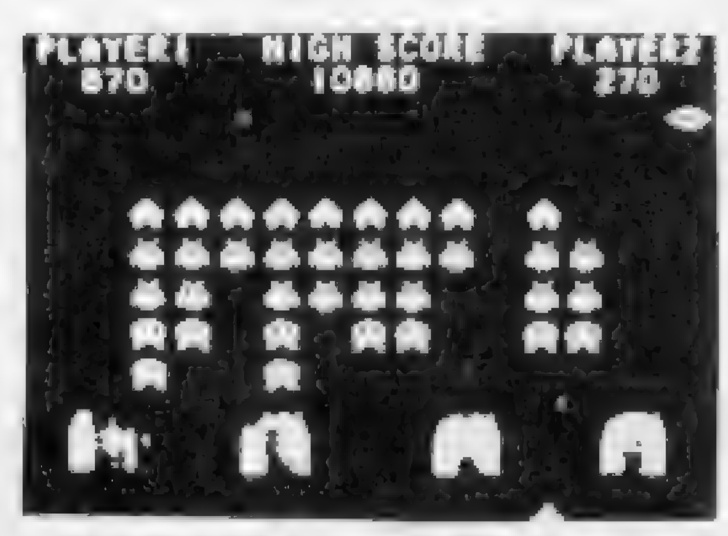

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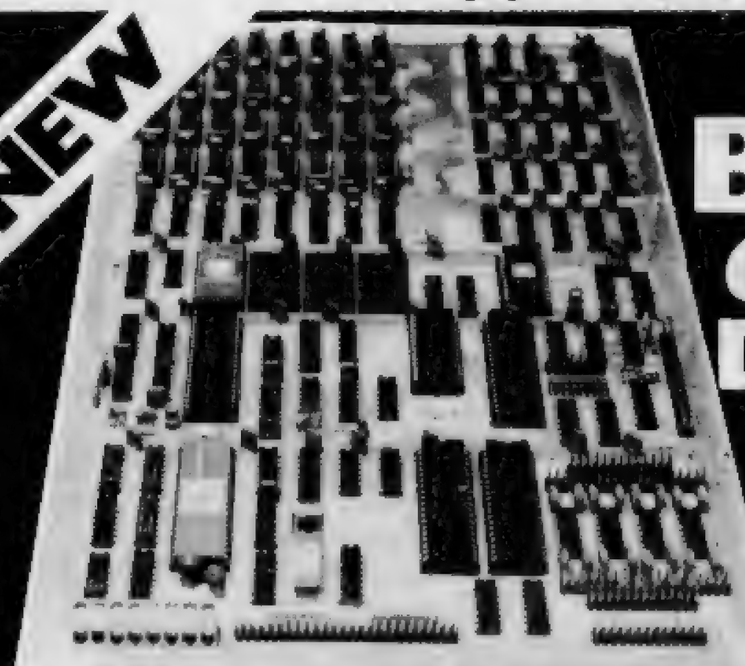

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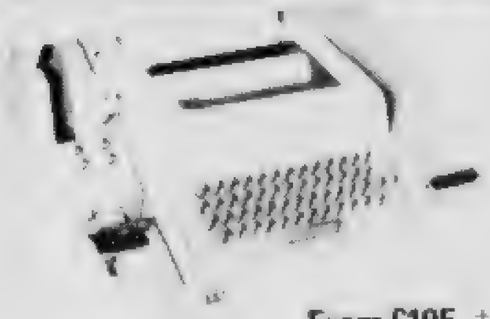

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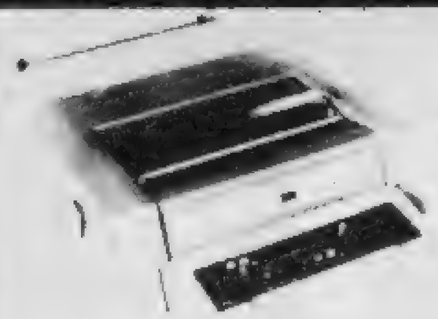

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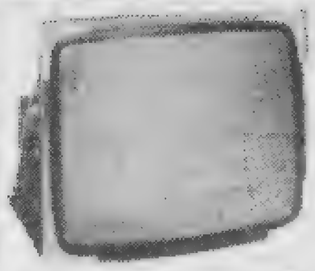

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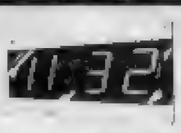

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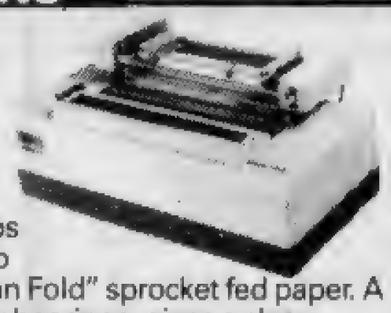

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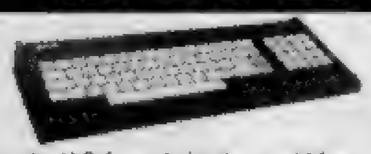

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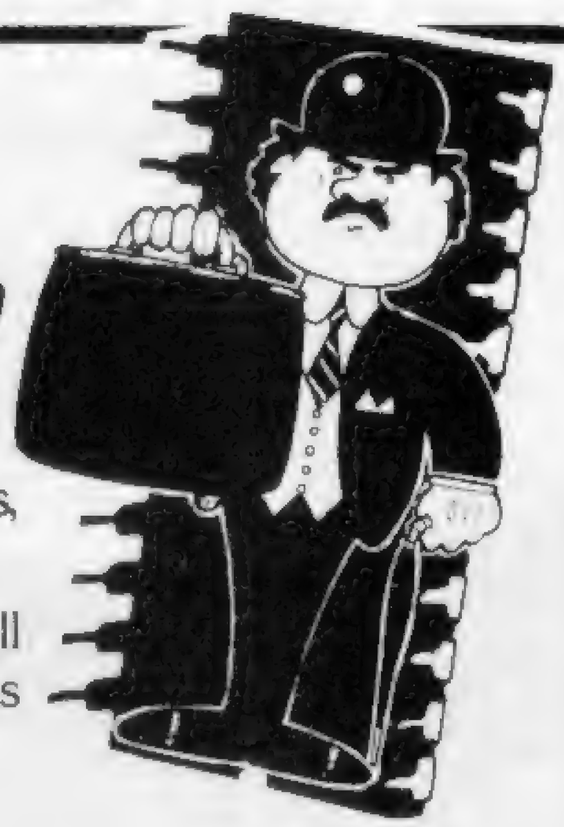

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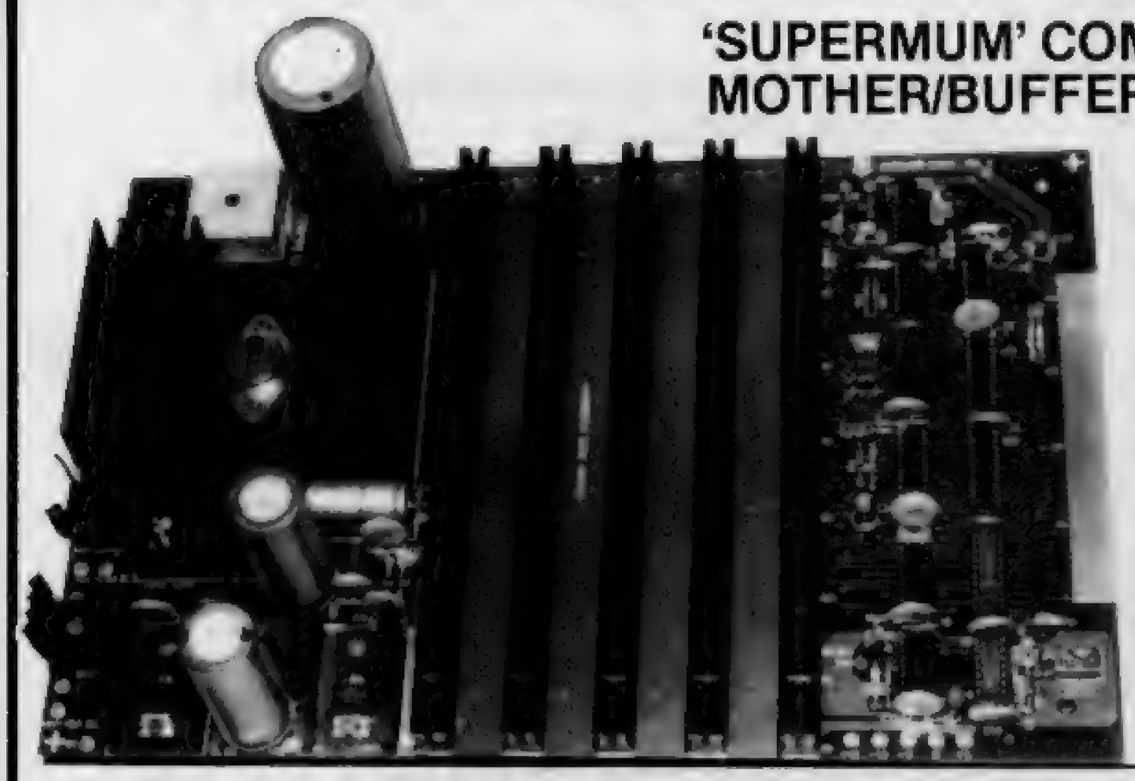

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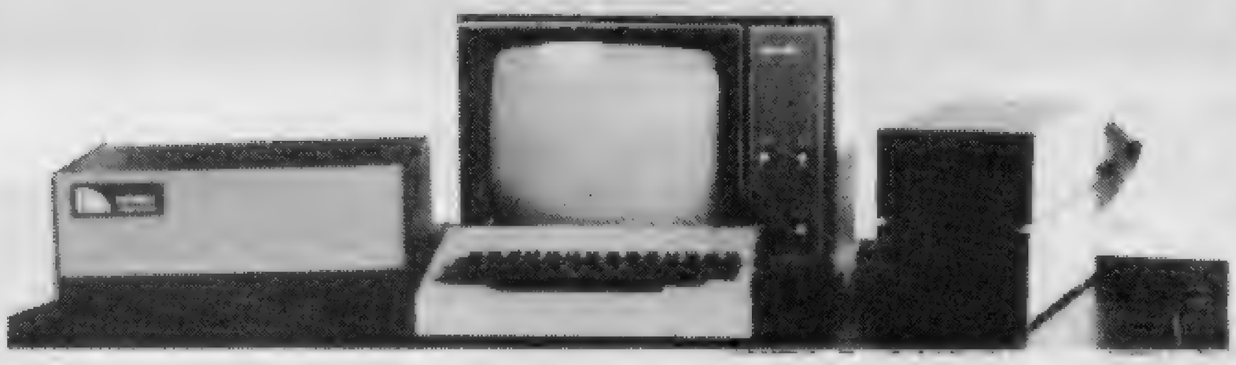

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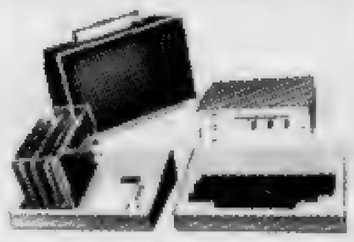

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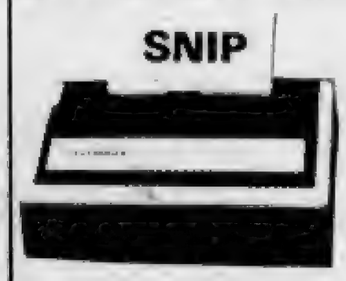

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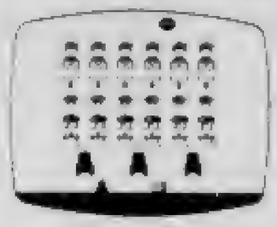

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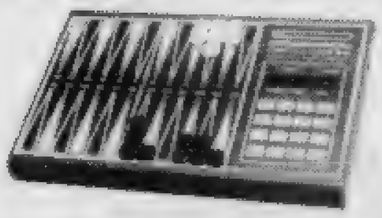

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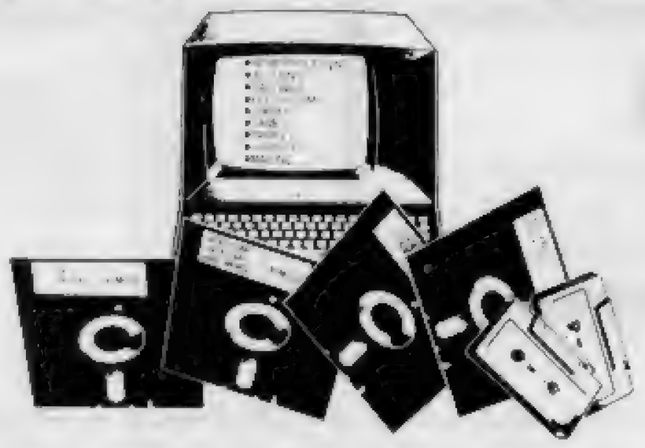

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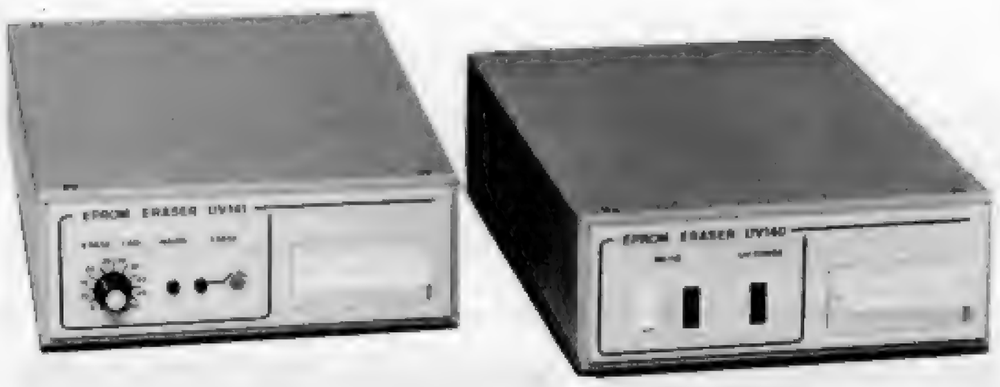

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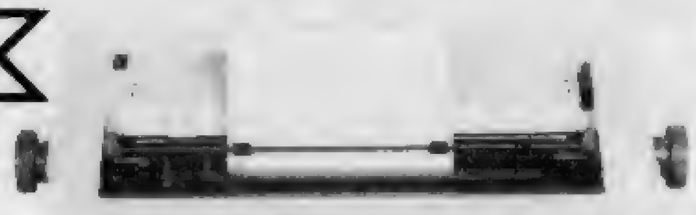

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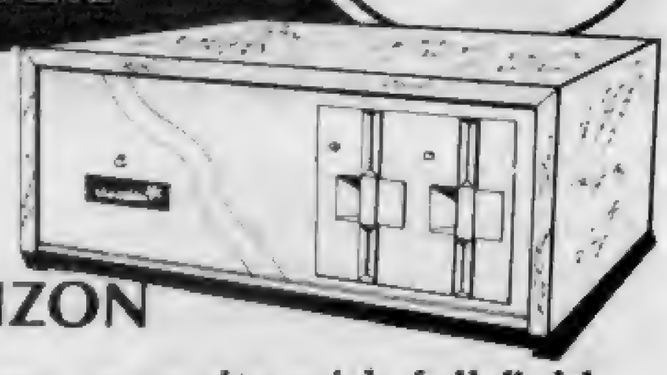

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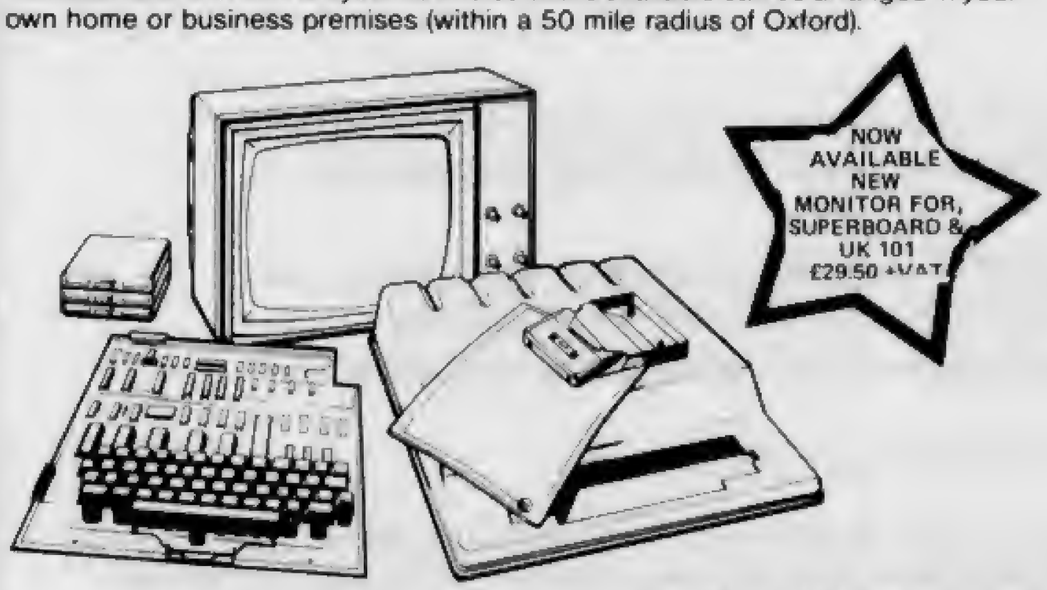

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West Centre Hotel, London SW6.

Thursday 18th June 1.00pm — 7.00pm.
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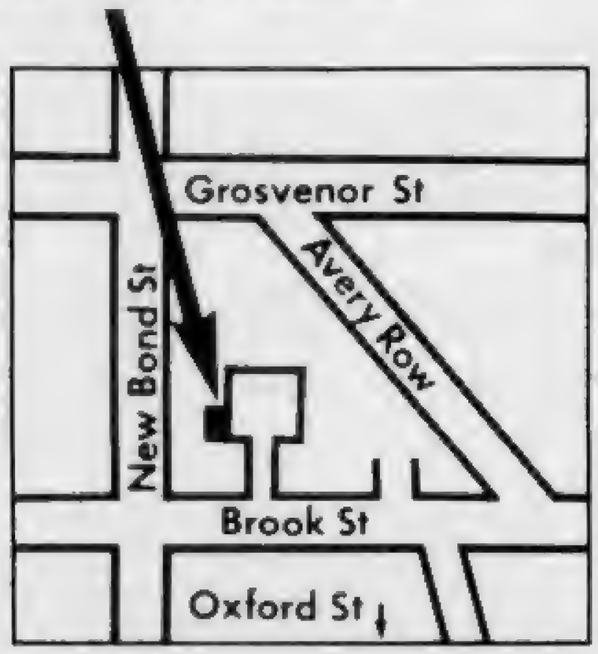

The Sinclair ZX80 is innovative and powerful. Now there's a magazine to help you get the most out of it.

Get in sync

SYNC magazine is different from other personal computing magazines. Not just different because it is about a unique computer, the Sinclair ZX80 (and kit version, the MicroAce). But different because of the creative and innovative philosophy of the editors.

A Fascinating Computer

The ZX80 doesn't have memory mapped video. Thus the screen goes blank when a key is pressed. To some reviewers this is a disadvantage. To our editors this is a challenge. One suggested that games could be written to take advantage of the screen blanking. For example, how about a game where characters and graphic symbols move around the screen while it is blanked? The object would be to crack the secret code governing the movements. Voila! A new game like Mastermind or Black Box uniquely for the ZX80.

We made some interesting discoveries soon after setting up the machine. For instance, the CHR$ function is not limited to a value between 0 and 255, but cycles repeatedly through the code. CHR$ (9) and CHR$ (265) will produce identical values. In other words, CHR$ operates in a MOD 256 fashion. We found that the "=" sign can be used several times on a single line, allowing the logical evaluation of variables. In the Sinclair, LET X=Y=Z=W is a valid expression.

Or consider the TL$ function which strips a string of its initial character. At first, we wondered what practical value it had. Then someone suggested it would be perfect for removing the dollar sign from numerical inputs.

Breakthroughs? Hardly. But indicative of the hints and kinds you'll find in every issue of **SYNC**. We intend to take the Sinclair to its limits and then push beyond, finding new tricks and tips, new applications, new ways to do what couldn't be done before. **SYNC** functions on many levels, with tutorials for the beginner and concepts that will keep the pros coming back for more. We'll show you how to duplicate commands available in other Basics. And, perhaps, how to do things that can't be done on other machines.

Many computer applications require that data be sorted. But did you realize there are over ten fundamentally different sorting algorithms? Many people settle for a simple bubble sort perhaps because it's described in so many programming manuals or because they've seen it in another program. However, sort routines such as heapsort or Shell-Metzner are over 100 times as fast as a bubble sort and may actually use less memory. Sure, 1K of memory isn't a lot to work with, but it can be stretched much further by using innovative, clever coding. You'll find this type of help in **SYNC**.

Lots of Games and Applications

Applications and software are the meat of **SYNC**. We recognize that along with useful, pragmatic applications, like financial analysis and graphing, you'll want games that are fun and challenging. In the charter issue of **SYNC** you'll find several games. Acey Ducey is a card game in which the dealer (the computer) deals two cards face up. You then have an option to bet depending upon whether you feel the next card dealt will have a value between the first two.

In Hurkle, another game in the charter issue, you have to find a happy little Hurkle who is hiding on a 10 X 10 grid. In response to your guesses, the Hurkle sends our a clue telling you in which direction to look next.

One of the most ancient forms of arithmetical puzzle is called a "boomerang." The oldest recorded example is that set down by Nicomachus in his *Arithmetica* around 100 A.D. You'll find a computer version of this puzzle in **SYNC**.

Hard-Hitting, Objective Evaluations

By selecting the ZX80 or MicroAce as your personal computer you've shown that you are an astute buyer looking for good performance, an innovative design and economical price. However, selecting software will not be easy. That's where **SYNC** comes in. **SYNC** evaluates software packages and other peripherals and doesn't just publish manufacturer descriptions. We put each package through its paces and give you an in-depth, objective report of its strengths and weaknesses.

SYNC is a Creative Computing publication. **Creative Computing** is the number 1 magazine of software and applications with nearly 100,000 circulation. The two most popular computer games books in the world, *Basic Computer Games* and *More Basic Computer Games* (combined sales over 500,000) are published by Creative Computing. Creative Computing Software manufactures over 150 software packages for six different personal computers.

Creative Computing, founded in 1974 by David Ahl, is a well-established firm committed to the future of personal computing. We expect the Sinclair ZX80 to be a highly successful computer and correspondingly, **SYNC** to be a respected and successful magazine.

Order SYNC Today

Right now we need all the help we can get. First of all, we'd like you to subscribe to **SYNC**. Subscriptions are posted by air directly from America and cost just £10 for one year (6 issues), £18 for two years (12 issues) or, if you really want to beat inflation, £25 for three years (18 issues). **SYNC** is available only by subscription; it is not on newstands. We guarantee your satisfaction or we will refund the unfulfilled portion of your subscription.

Needless to say, we can't fill up all the pages without your help. So send in your programs, articles, hints and tips. Remember, illustrations and screen photos make a piece much more interesting. Send in your reviews of peripherals and software too—but be warned: reviews must be in-depth and objective. We want you to respect what you read on the pages of **SYNC** so be honest and forthright in the material you send us. Of course we pay for contributions—just don't expect to retire on it.

The exploration has begun. Join us.

The magazine for Sinclair ZX80 users

SYNC

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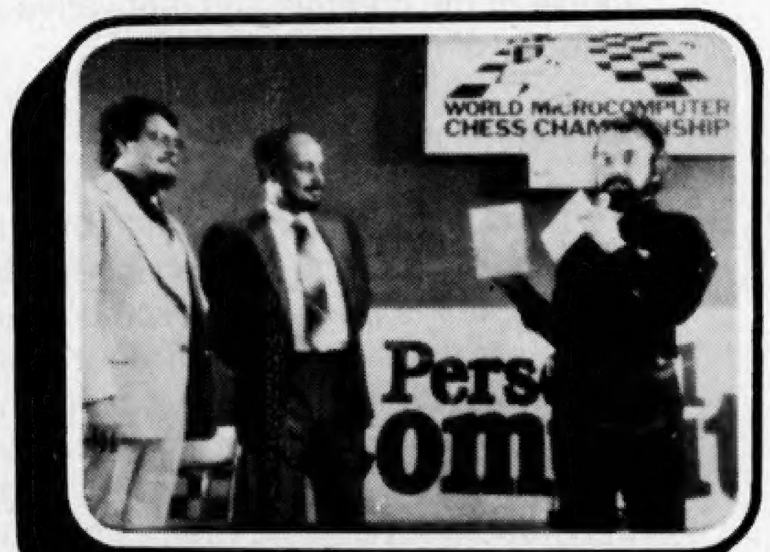
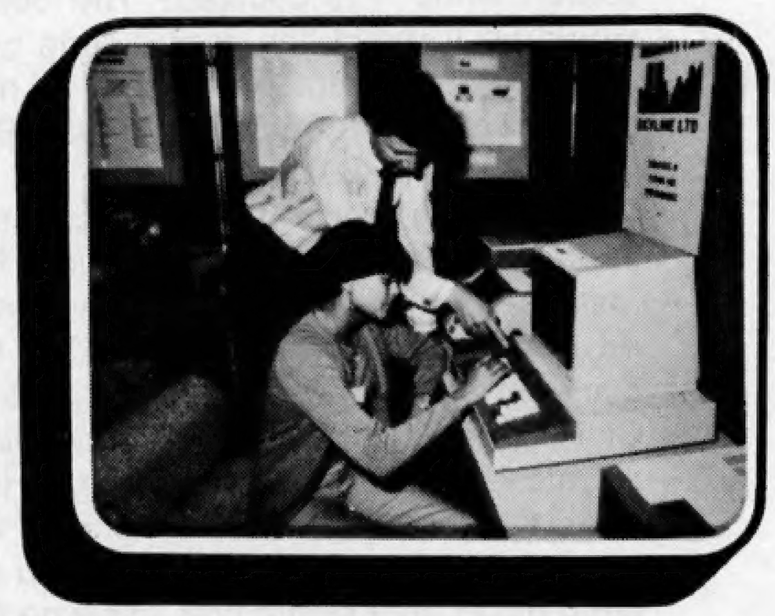
The 4th Personal Computer World Show

Cunard Hotel Hammersmith 10-12 September 1981





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CHIPCHAT

Congratulations to Personal Computers' Mike Sterland and family on the recent arrival of a baby boy. We understand he's now got one of each. Quit while you're winning, Mike. . . That nice man from Supersoft, Peter Calver, recently picked up a job lot of reject Petsoft cassettes to sell as 'lucky dip' items at 50p each. Many delighted buyers rang him to say that, thanks to Alan Shelley's recent 'Get well soon' article in *PCW*, they managed to recover the software which was on the tape before its rejection. . . It's nice to see that Lifeboat, the CP/M software mail order specialist, is back in business under new management. Helen Smith is in charge, and she can be contacted on 01-836 9028. . . Editor Tebbutt managed to get himself reported in his local rag recently. Among other things it accused him of visiting Silicone Valley last year. His wife, Sylvie, says she can't understand this accusation since she's never been near a cosmetic surgeon in her life. . . The organisers of the recent Microsystems '81 show won't thank us for reporting that invitations were still being posted on 11 March — the first day of the three-day show! We have the envelope to prove it. . . Shortly after 'Uncle' Clive Sinclair's withering comments about the BBC at his ZX80 launch, guess who his secretary had lunch with? Yes you've got it, one of the team in charge of the forthcoming Acorn-based TV series. All can be forgiven when we tell you that it was the only spare seat in a very crowded room. And the BBC man did have the grace to blush furiously . . . Look out for Zilog's answer to Unix. It's called Zeus and will run on a soon-to-be-announced, Z8000-based system, provisionally named the MCZ3. We also hear that Zilog plans to licence its neat Z-Net interface hardware and software.

We present the first of an occasional series of specially selected mug-shots. For some as yet unfathomed reason, some PR companies believe that they add weight to their press release. This is Jon Baldachin (see last month's 'Newsprint').

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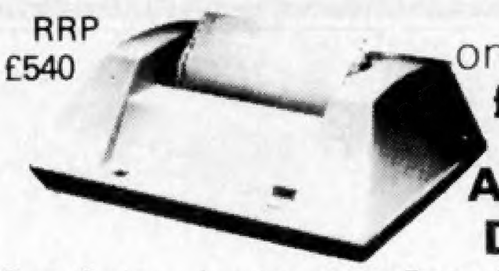

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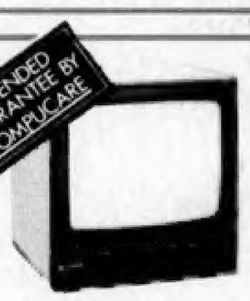

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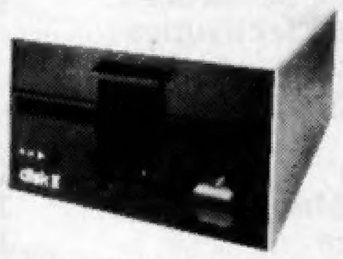

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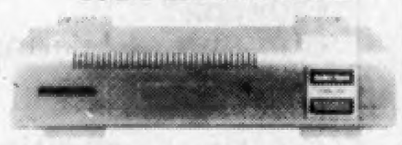

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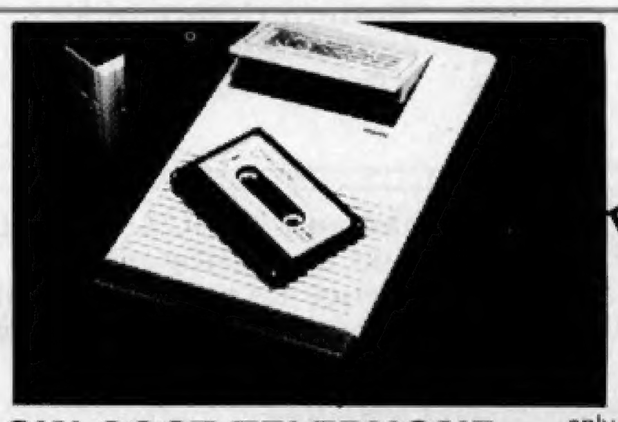

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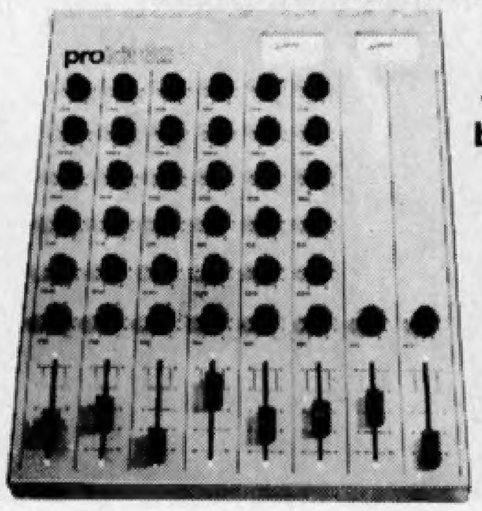

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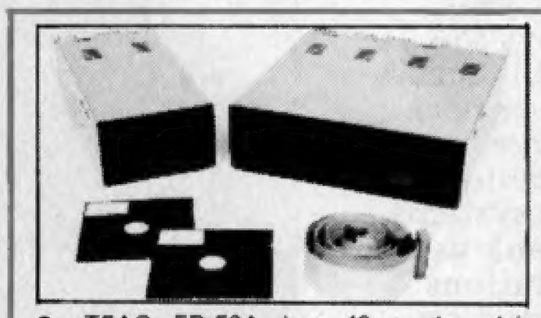

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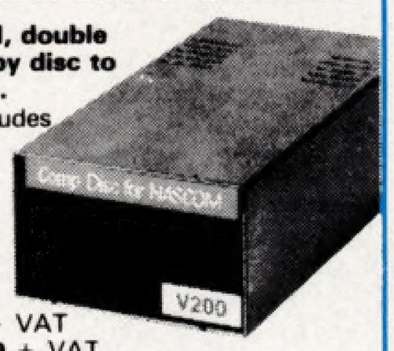

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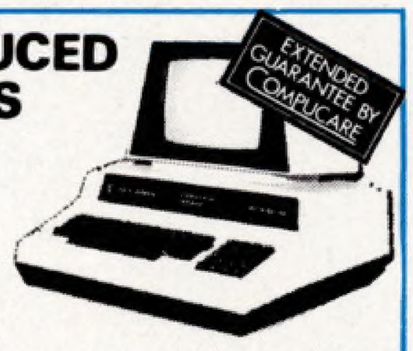

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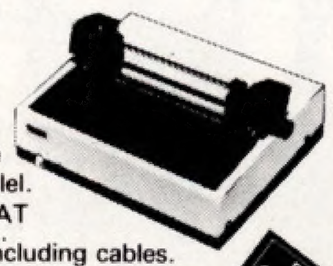

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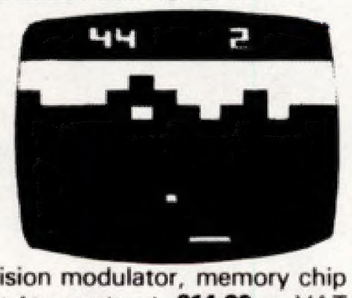

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